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THE EDITOR will be pleased to consider Literary Contributions dealing with subjects within the purview of this Magazine, and to make satisfactory arrangements with Contributors if MSS. be accepted for publication. High-class engravings from photos and drawings will be prepared free of cost to the writer

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This issue is the third number of Vol. III.

The American Mechanic.

FROM some of the more recent articles in *The Times* on "American Engineering Competition," the observant reader may pick out interesting and significant facts relative to labour conditions in the United States. Two of the articles to which we refer are professedly devoted to "The Labour Question," but they contain nothing new to engineers for they simply recite the preposterous state of things still existing in this country. Nevertheless, we are glad to see such facts stated in *The Times*, as nothing but good can result from the publication of the unsound and pernicious doctrines held, or perhaps it would be more correct to say, professed by Trades Union officials. Our present object is chiefly to collate some of the scattered observations made by the correspondent of our contemporary, as the result of his visits to various engineering establishments in America.

One of the characteristics of social, official, and industrial economy prevailing in Great Britain is that promotion from one grade or caste is difficult, although not actually impossible. There is much less class distinction in the United States, a country where merit has some chance of adequate recognition. Take the case of outdoor foremen, who go out to inspect work in progress. These are said to be picked men, "as it is considered that quick delivery — always a feature of supreme importance in America—largely depends on their exertions. They not only have to see that the materials comply with the specifications, but also to take care that the firm's work gets its fair turn, and that it is not unduly put on one side to favour other orders." Inspectors of this class are always paid by salary, but it is distinctly understood that advancement depends upon ability and attention to duty. Further, it is well known that no efforts are spared in searching for the most deserving men to fill the best positions on the staff of any given firm. Every employee knows that a place is waiting for him if he can but prove his mettle, and opportunities are afforded throughout his career, "whether he begins as labourer in the works or messenger boy in the office." The fortunate holders of more important positions have almost invariably been chosen for their ability, and not because of the extraneous circumstances frequently influencing appointments in our own land. No doubt can exist that this is one of the features largely responsible for American industrial prosperity.

At the Baldwin locomotive works, where nearly 7,000 men are employed, piecework is the rule, chiefly because the men themselves insist upon this system. These works are in continuous operation, the day and night men being in partnership. British employers have hitherto considered the difficulties of continuous work to be practically insuperable. On the other hand it is entirely successful at the Baldwin and other large works in the United States, probably in consequence of the different sentiments animating American mechanics. Even during the dinner-hour the engines continue to run, and a large number of machines are at work. The object of the firm naturally is to get all the work possible from each tool, and the men, being on piecework, say, "I may as well let my machine go on earning money for me so long as I am here, even if I am eating my dinner the while." Another point worthy of note is that no restrictions are made as to the speed of running machine tools, for the men are anxious to turn out the maximum quantity of work for their own sakes. A remark made to *The Times* correspondent on this subject is significant. An American mechanic "said he wondered how the British workman could keep awake with machine tools running at the rate usual in England."

Even when piece-work is not adopted, there is no trades-union rule limiting the number of machines under the supervision of one man. The more the merrier is the motto of the American, and moreover he is always ready to suggest improvements in the tools for the economy of labour, frequently offering to accept lower rates if the alterations be made.

We should like to hear of British mechanics acting in this way. Perhaps we shall when the millennium has arrived, but unless he learns wisdom it is by no means certain that the British workman will survive long enough to witness the advent of that happy period.

According to Mr. Vauclain, the works manager at Pittsburg, the men are quite satisfied if they earn more money in consequence of their suggested improvements, and the firm receives benefit at the same time because each unit produced costs less money.

But Mr. Vauclain points out, "We never try to cut the rate so long as the man making the improvement keeps at the job. If he can earn very high wages we let him earn them. We consider he has a vested right in the improvement." This, it appears to us, is very politic as well as very fair, and the practice is one admirably illustrating the identity of interest uniting employer and employed in the United States. As a general rule the Baldwin men earn "good money," and, unlike some classes of our own mechanics, they stick to their work instead of devoting three or four days a week to the earning of what they think is just sufficient to live upon.

At the works of The Edward P. Allis Company, of Milwaukee, the hours of work are from 7 a.m. to 6 p.m., with an interval of an hour for dinner. The night shift is from 6 p.m. to 7 a.m. the next morning, with an interval of one hour after midnight. Most of the men here are paid by the day, piece-work being the exception. In spite of this circumstance there appears to be no objection to the use of labour-saving plant, as the works are equipped throughout with the most perfect modern tools and appliances.

On visiting the engine works of Messrs. Fraser & Chalmers in Chicago, the representative of *The Times* found all the plant to be of the most modern description; the lifting appliances in the shape of electric cranes and pneumatic hoists being especially well devised. The latter, he adds, "are worthy of attention, as they save a great deal of labour." Throughout the shops there are fitted a series of over-head rails at a convenient height above the machine tools. Hanging from these rails are lifting cylinders furnished with hooks, so that a piece of work can be transported from one place to another with a minimum of labour. Here the shops are kept open day and night, the men who work in shifts making 58 hours a week. No difficulty is experienced in the transference of work from one shift to the other, and piece-work is by no means the rule. This firm, as our readers are no doubt aware, established works some time ago near London, with the hope of reducing the cost of production by the aid of British labour. The expectation does not appear to have been fulfilled, probably because English labour is so much dearer than American proportionately to production. At any rate the experiment furnishes a useful object-lesson, which we commend to the attention of trades unions generally.

In this connection we may quote the remarks made to *The Times* correspondent by the managing director of a large works in Cincinnati, on the subject of "British lack of enterprise." He said: "In England you are satisfied to go on in the same old way; Americans are never satisfied. A few years ago we made the leading machine for producing wheel spokes. With four of these, attended by one man, we could make 3,500 spokes a day. That was the best machine of its period, but we saw better work could be done, and we knew if we did not do it someone else would. So we improved our designs, with the result that at the present time our machines, *fed by one boy*, will make 12,000 to 18,000 spokes per day."

American engineers have an incentive to produce improved machinery because they know it will be sought after by employers

and welcomed by workmen. In this country it is not always possible to get improved tools used, and cases are often reported where English mechanics have threatened to strike if certain labour-saving appliances should be introduced. The experience of *The Times* commissioner is that piece-work, instead of being opposed by a powerful union, is universally popular in the United States. The men want to work and make money, not to loaf about and earn just enough for food and beer. Moreover, an American mechanic is obliged to work, or he will be very promptly dismissed. Instead of the shop foreman being a poor tool of the union, he is generally an honest man who fearlessly looks after his employer's interests. And his own, too; for if he does not ensure good results he is liable to be replaced by someone else who will. Workmen are paid on their merits, and it may safely be said that the standard of efficiency is much higher than that prevailing in Great Britain. We have touched very lightly on this subject, but it is one whose importance cannot be over-estimated.

Something has been done in this country to improve matters, but very little, and there are no signs of any great movement towards further organisation on the part of the engineering employers. On every hand we see a growing tendency for municipal bodies to join the conspiracy against industrial prosperity by insisting on the trades-union labour clauses in all contracts. Occasionally we hear that members of the Engineering Employers' Federation are so wanting in good faith as to accept contracts in which such clauses occur. More than this, we have even seen a specification, drawn by the London agent of a firm associated with the Employers' Federation, in which the same pernicious clause was inserted.

So long as apathy, jealousy, and sometimes disloyalty, continue to be the distinguishing features of employers, so long will the mechanic be master of the situation. British employers, as well as British workmen, have still a good deal to learn from the United States.

The Gold Coast.

It has been said concerning the native tracks of Africa, that if you started from the West Coast and took any track into the interior, bearing eastward, you could, if you knew the way, walk right across the continent to the Indian Ocean without once leaving the beaten track. There is no such maze of paths in the whole world as can be found in Africa; and yet these paths have never been made as the deliberate work of man. There is no radical difference between them and the tracks of wild animals, save that they are probably older, harder, and not quite so narrow; yet they are seldom more than a foot wide, and frequently not even that. In all warfare other than the most primitive, transport is an important factor. In such a country as the West Coast modern warfare becomes mainly a mode of transport. It is the difficulties in connection with this work which has made the trouble in Ashanti anything more than a nine days' wonder. The generality of Englishmen have about as distinct a notion of the West Coast of Africa as they have of the Antarctic Continent, and, as it is highly probable that much blood and treasure may yet have to be expended upon this cryptic land before it settles down as a portion of Greater Britain, it may be well to devote a few lines to a skeleton summary of the subject, with particular reference to the reasons why we are there, why the natives are in revolt against us, and what we are going to do in the future.

When the Portuguese, who were the first European explorers, first landed in the Bight of Benin they found the native women washing gold dust out of the sand on the seashore, just as those women's descendants wash it now. The name of the Gold Coast was not idly given. It is little exaggeration to say that every man and woman in this part of Africa, and for some way into the hinterland, possesses a gold ornament, big or little. The graves nearly always contain gold, buried very much after the old Gothic manner with the corpse, so that the departed might have the wherewithal to make a start in

the next world. In the western part of the colony—in Cape Coast (the town), Almina, and Sekundi, after a heavy shower of rain, the women may be seen washing gold out of the very mud of the streets. In Sekundi Bay the washing of gold on the seashore yields from 3s. to 10s. a day to the labourer; and here, it may be remarked, there are observable at least three thin beds of conglomerate. It is conjectured, reasonably enough, that the bed of the bay itself contains, and that at a depth of a couple of fathoms or so, an immense and probably rich deposit of gold which has never been touched, and awaits the hand of science. There is gold in the rivers; there is gold everywhere! The problem is how to win it profitably.

Starting from a point just north of Axim, and running a line through Dix Cove, Sekundi, Almina, Cape Coast, Anamaba, and trending north-east, the country so enclosed is simply honeycombed with shafts sunk by natives. For the most part these are abandoned gold workings. The native works down until he is stopped by water. He is not equipped mechanically or mentally to battle with such a difficulty as the flooding of a mine. There is a mining proverb, as true as most proverbs, that the best part of the reef is always under water. If this applies to the Gold Coast workings, then, notwithstanding the antiquity of the native industry, only the poorer earth has yet been mined. Generally speaking, it does not pay the native to work a reef of less than 2 ozs. to the ton, which represents about the minimum value of that which has hitherto been handled. On the Witwatersrand goldfields the average richness of the quartz has been about 12 dwts. to the ton. If it had not been for the fear of the climate, and if equal energy had been applied to the West Coast mining, how would the gold output of the latter have compared with that of the Transvaal? In brief, then, the great attraction of the West Coast is gold. It is the principal *quid pro quo* which the native can give in return for old muskets, new calico, newer rum, beads, bibles, and what not. In the main, notwithstanding the importance of the rubber industry, we have gone, and have remained, on the West Coast of Africa to get gold.

When King Prembeh concluded that discretion was the better part of valour and gave us the key to Koomassie, there was no fighting worth mentioning. The British Government, if their acts can be taken as a true translation of their opinions and intentions, considered that the country, so far as the region over which Prembeh ruled, was conquered. If this was their opinion it was a profound mistake. It was a blunder, indeed, which is costing us dear. That mistake alone, however, might not have spelt insurrection for an indefinite period had it not been followed by other blunders. Governor Hodgson, recently beleaguered at Koomassie, has demanded the production and surrender of "the golden stool." How far the supposed £ s. d. value of this piece of furniture may have prompted the Governor to acquire possession of it, if possible, it would perhaps be impertinent to inquire, though it may be said, in passing, that our West Coast Protectorates are expected to pay expenses—except in war time. It is likely, however, that the demand for the golden stool was made with the idea that the possession of it would tend to consolidate our authority over the natives, and that inasmuch as they regard the object with a superstitious reverence, it was undesirable for it to remain in the possession of anyone not representing the British Government.

Another bone of contention between the British authorities and the native chiefs is the land tenure. Governor Hodgson has calmly intimated that the ownership of all land in Ashanti is vested in the British Government. Now this question of land ownership is the crux of the whole trouble which has culminated in insurrection. The golden stool grievance appeals to the sentiments of the people at large. The land question is a matter of vital interest to the people, and particularly to the chiefs. When the history of this affair comes to be written it will probably turn out that the chiefs,

alarmed and indignant at their agrarian privileges being encroached upon, had used the golden stool demand as a means of gathering the people around them in arms. Whatever the minutiæ of the movement may be, it may be taken for granted that if the golden stool had been left severely alone and the Ashanti land question had been allowed to sleep for awhile, there would have been no such rebellion as we now have to cope with. In a conversation which we had with the late Miss Kingsley, not long after she returned from the West Coast, she compared the policy of the British with that of the French. "The French don't have so much trouble with the natives as we do," said Miss Kingsley, adding "I think we fuss about and meddle too much with them." If we had not made a fuss about the golden stool it might have been better for all concerned.

To return to the transport question. The Government have recognised that railways are a first desideratum in such a country. They have been pushing a railway into the interior steadily, but very slowly. The question of whether railways should be built in the Protectorate by private enterprise or by the Government has been a burning one. The Government decided there should be no private enterprise in this direction, and they have consistently refused permission to everyone who was desirous of taking up such work. We fully recognise that in the peculiar circumstances, the arguments in favour of retaining all such work in Government hands would appeal to the official mind as overwhelming. But, in refusing to give facilities to private individuals, the Government took a responsibility of great magnitude. With a full knowledge of the facts, so far as they can be ascertained, we can venture the assertion that if a light pioneer railway had been entrusted to private enterprise, by this time the line would have reached Koomassie. The distance from the Coast to that place is about 180 miles. As it is, about 45 miles have been built. Again, the value of such a line would be immensely increased by a few spur branches which could be constructed to carry the light traffic they would attract at very small expense. But the Government will listen to no such thing. In effect they have been acting the part of the dog in the manger. They will not proceed vigorously with railway building themselves, nor allow anyone else.

We wish we could express the conviction that the blunders of the past will teach wisdom for the future. But there are two things which especially should be avoided, and one thing we should be careful to do. The land should not be stolen from the natives even by legal form, and we should not ride roughshod over their customs and superstitions. Also, we must provide an effective force, military and police, before attempting to enforce our authority in Ashanti. The "three men and a boy" system will never do, and in the end will be most costly, both in lives and money.

Factory Legislation.

We have all become so Socialistic now that we do not stop to consider how violently we have interfered with the liberty of the subject in our Factory laws. The theory, or popular conception, of the principle of these laws is that the State should throw a protecting arm first over the child, and next over the woman, at all times, but only in case of great need over the adult man. Needless to say, we have long since got beyond that, and in the Factory laws as they now exist there is a perfect—or rather imperfect—system of interference with adult male labour. These laws are constantly being altered and enlarged, but the lines of alteration by no means follow the sequence of the theory. As yet they do not include the limitation of adult labour to eight hours per day in all occupations, but there are men who argue that it is not novel and is perfectly legitimate for the State by legislation to regulate the duration of the working-day, because the Statute of Apprentices of Queen Elizabeth's time limited the day's labour of journeymen, as well as of apprentices, to twelve hours in summer and to from daybreak to nightfall in winter. But if we are to admit anything to be

right and proper merely because it was lawful in the days of Queen Elizabeth, we shall be landed in a queer mess. The Factory Acts as they now stand on our Statute-book were not primarily designed for the regulation of industry, but for the establishment of wholesome and reasonable conditions of labour, and for the prevention of oppression of women and children by overwork. And here it may be remarked that the Factory laws have always been resented by many women as an unjust encroachment upon the liberty of woman. They certainly are scarcely in harmony with modern ideals of the personal responsibility, and economic and social independence, of women. And they are certainly destructive of the system of small employers and master workmen, out of whom our industrial prosperity has grown. We have gained a great deal, no doubt, under the Factory system, but we have also lost a good deal in the master craftsman. It is claimed that the uniform effect of the Factory legislation of the past has been to encourage the use of machinery, division of labour, production on a large scale, and to increase the employment of women. We are not concerned just now with the political aspects of the question. It may be perfectly true that, as Mr. Benjamin Kidd says, "The advent of Demos is the natural result of a long series of concessions, beginning in England with the passing of the Factory Acts and the legalisation of combination, and leading gradually up to the avowedly Socialistic legislation for which the times appear to be ripening." It is the industrial and economic aspects that are of the most immediate interest for those who write for these pages and for those who read them; and we are convinced that the real incidence on the costs of production of the Factory laws of this country has never yet been thoroughly investigated. It is too big a subject for treatment in a brief article like this, but our point is, that if the working-classes realised how much larger might be the rewards of labour but for the interference of the State in labour affairs, they would clamour for immediate repeal of the Factory Acts. As it is, they chafe under them, quite as much as does the works manager, who knows so much better than an Inspector of Factories how a workshop should be conducted, yet who finds himself compelled to obey contradictory orders of officious officials. Does he not know that Inspector who puts him to the expense of fencing a wheel that nobody will go near, and boxing in a bit of machinery that is perfectly harmless while it is visible? And does he not also know that other Inspector, who, next visit, will demand the instant removal of both fencing and boxing as highly dangerous? The vagaries of the official Inspectors may be highly amusing, but they are also highly expensive for the employer. The workman has his opinion of the official, and it is not always complimentary, nor such as Trade Union officials would care to repeat when applauding the Factory laws and demanding more of them. The fact is that there is less need than ever there was for Factory legislation—now when both Labour and Capital are so highly organised in the great industries, that all questions which arise can be adjusted in a quiet talk round a table, each side respecting the strength of the other and recognising its rights. Yet Parliament, in a recent Session, prepared to add another complexity to the most complicated code of laws that ever cursed a civilised country. The Factory Acts over-ride the whole field of industry, superintend every process, limit the discretion of every employer, fetter the freedom of every worker. There are so many of them, and they are so bewildering, that only a legal expert can interpret them—and *he* does not understand them. They are overburdened with detail, and are framed as if some of the most important industries of the country were carried on by idiots. To them is some day to be added the last Factories and Workshops Bill, which the London Trades Council, and other labour organisations, have so fiercely assailed.

We may or may not agree with the reasonableness or the desirability of the provision under existing Acts for the regulation of "dangerous trades," but we can all agree that there should not be one law for Tom, another for Dick, and perhaps

none at all for Harry. If the "dangerous trades" are to be regulated they ought, in justice to all employers and employees, to be under uniformity of regulation. The system under which a trade can now be declared "dangerous" may be crude and objectionable, but it is certainly absurd that when a trade is so declared, special rules for the regulation of it cannot be applied to the whole trade, but must be proposed to the employer of each workshop separately. The employer may accept or object to the rules, and in the latter case there is appeal to arbitration. And the results of arbitration are so uncertain that in the same trade one factory may be under one set of rules, one under another set, and one under none at all. The substitution of a Referee appointed by the Home Secretary, to hear all parties who object to a draft of proposed regulations, is not enough. Such a reference may secure uniformity of practice, but the fact remains that regulations which may be reasonable enough in one factory may be unjust and onerous in another. In saying this we by no means traverse what we have said above about the absurdity of the operation of the existing system. There are, for instance, long-established factories, in the centres of towns which have grown up around them, that cannot in the nature of things come up to the standard of sanitation and amenity attainable in newly-erected factories in non-populous districts. Yet they are able to carry on with as much security to life and limb and health as they have been carried on for, perhaps, generations. Are such factories to be proscribed and refused certification because a suddenly evolved new code of rules is inapplicable to these special conditions and circumstances? Such cases are obviously not for casual treatment by a general referee, but for careful and special consideration by a suitable arbiter. There are several other points in which the suspended Bill is objectionable, even as an amending and simplifying measure, but the chief is in providing for the prohibition of the use of dangerous processes and materials. We object altogether to any Department of State, or any set of officials, however accomplished and disinterested, being endowed with the power to stop any industry, or to prevent any man from employing his labour in any honest, however dangerous, work. It is not a mere paradox to say that a dangerous occupation can be followed with perfect security if reasonable precautions are taken. It is dangerous for any ordinary person to walk along a sloping roof, but it is not dangerous for the slater, who is born and bred to it. If any industrial occupation may be prohibited because it is dangerous, where are we to draw the line? Why, we all face more dangers daily in the street and in the railway train than an employee in a gunpowder factory does in his daily work! If we are all Socialists now, as Sir William Harcourt says, we need not be "mollycoddles" also. Let us drop grandmotherly legislation, and pray for the appearance of some Heaven-born genius able to codify and simplify the Factory laws.

The Great Coal Question.

We are being assured by those interested in the coal trade that there is not the slightest reason for anticipating any reduction in the current price of coal, and that manufacturers may therefore resign themselves without further question to the inevitable and order their stocks with what cheerfulness they can muster under the circumstances. The chief organ of the coal industry, indeed, complacently observes that the price of coals has for long been much too low, and that the colliery owners now are only justly recouping themselves for the losses they have been sustaining during many years.

There can be no question that this sort of argument is the sheerest nonsense. The fact is patent that the present inflated prices have been attained simply by curtailing production, and thereby creating an artificial scarcity in the market. Although the demand for coal is greater than it has been in recent history, the

colliers are all working on short time, whilst maintaining the full standard of their weekly earnings. There is no doubt, also, that the movement for the establishment of an artificial price for fuel is highly organised, and that it has been carried out with singular skill by those concerned. Immense profits are being reaped by individuals to the detriment of our manufacturing industries, and therefore to the interests of the country in general. Coal being the very root and foundation of all productive industry, and besides a natural product that once exhausted cannot be replaced, is not to be considered in the light of ordinary merchandise, though it is being treated as such by those who control its trade. The time may arrive, therefore, when the production and disposal of this commodity may become the subject of State interference and even State control, for it is manifestly impossible to allow the industries of the greatest manufacturing nation in the world to be hampered by a number of irresponsible individuals who may choose to combine for the purpose of making exorbitant profits at the expense of the general community.

From a strictly logical standpoint, the argument that the coalfields should be the property of, and be administered by, the State is simply unassailable. Our coals are the very foundation of our existence as a manufacturing people, and it appears absurd that a natural geological deposit of such inestimable value should be at the mercy of, and submitted to, the caprice of private individuals. The existence of such anomalies, however, is a familiar feature of the British constitution, in the general signification of that very vague expression, and it requires a faith that would be almost superhuman, to hope for any legislative attempt at the removal of the coal anomaly at least in the immediate future.

The "coal famine" has been seized on as a subject of discussion by the general press, and many suggestions have been made in connection with it. In certain influential quarters a duty is openly advocated to restrict undue exportation, and reasons are assigned for this which we cannot deal with in the current article. For the present, we maintain, as already stated, that the rise in prices is due not so much to the export trade, but to decreased production effected by combined action on the part of colliery owners.

Accepting this to be the position, then, is the manufacturer utterly without defence, and must he submit unresistingly to the present, and whatever future, demands may be imposed on him? We do not think so. In the first place, public opinion would never tolerate the existence of anything in the nature of a "Trust" in the coal trade that carried its prices to such a pitch of exaction as to seriously menace manufacturing industry. The coal owners will not dare to push their prices to a point at which the manufacturer will refuse to pay. In other words, they are asking for as much as they can get, and taking just as much as the manufacturer is willing to give them. If he will give them more than they are getting they will cheerfully take it; should he refuse to give as much, they will have to be contented with what they can get. Just now it suits most manufacturers, crowded as they are with lucrative orders, to secure their coal on the best terms they can, coal being the first requisite, and its price to a certain extent a secondary consideration. But this state of things cannot go on indefinitely. As soon as business slackens the cost of fuel will take its position as a matter of primary importance, and the collieries will have to revert to the more reasonable rates of other days.

In any case manufacturers should, once for all, absolutely refuse to even consider the representations being made to the effect that existing market prices of coal are to be regarded as normal for the future, and if necessary they should meet combination by combination. It will be the duty each manufacturer will owe, not merely to himself, but to his neighbours. The prosperity of the nation's manufactures is a matter of interest to every one of its citizens, and in combating the exactions of the collieries they will have the cordial support of the great mass of the British public.

"We are, in the vastness of our possessions, losing our grip on national sentiment. It is our duty to maintain intact, and to defend by sea and land, all that our empire builders have left us. The day that sees the defence of the British Empire sapped, sees the disintegration of the Nation's trade and the hands of civilization's timepiece put back 200 years."—RT. HON. LORD CHARLES BERESFORD, C.B.

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The British Association . . .

So far as can be judged at the present time, the meeting of the British Association, which takes place this month in the city of Bradford, is likely to be particularly valuable to those practically engaged in local industries, as well as to the scientific world. It is 27 years since a similar gathering occurred in Bradford, and in the interval a great many changes have come about. The town has extended its borders on every side, the leading thoroughfares have been reconstructed, the population has been nearly doubled, and the borough has been raised to the dignity of a city, in which the achievements of science are worthily represented by various municipal and industrial undertakings. Like other communities in the same district, Bradford recognises in a very practical way the importance of technical knowledge, and we may therefore be certain that considerable interest will be manifested in the address by Professor H. W. Perkin on "The Modern System of Teaching Practical Inorganic Chemistry." After referring to the progress which has been made in the teaching of this science in schools, Professor Perkin will show that during the last quarter of a century similar progress has not been evidenced in universities and colleges with regard to inorganic chemistry. The speaker proposes to suggest modifications of the present system, and there can be no doubt that discussion of the subject will be both interesting and profitable. In the same section other important subjects are to be considered. Mr. W. H. Neville, F.R.S., of Cambridge, will open a discussion relative to questions arising out of recent research on metals and alloys; Mr. W. J. Pope, of the Central Technical College, will devote attention to recent developments in connection with asymmetric structures in carbon and other compounds; and Dr. Liebmann to recent improvements in the textile industries. Amongst other contributions of special industrial interest, we may mention the following: "The Relationship between the Heating and Lighting Power of Coal Gas," by Mr. T. Fairley; "The Treatment of Woolcombers' Effluents," by Mr. W. Teach; and "The Relations of Phosphorus, Iron, and Carbon in Iron and Steel," by Mr. J. E. Steed, of Middlesbrough. In the Geological section particular attention will be devoted to the carboniferous rocks, with special reference to the coal measures. In connection with the latter department of the subject, there will be a joint discussion in which the Botanical Section will take part, on the conditions existing during the growth of the forest which furnished the material for coal. This discussion is to be opened by Mr. A. Strahan, of H.M. Geological Survey, and it is expected that several eminent geologists, with special knowledge of the subject, will take part in the proceedings. Mr. Walcott Gibson will contribute a paper relative to the North Staffordshire coalfield; and Mr. W. Cash, of Halifax, will deal with the Lower Coal Measures of the West Riding. The report of a committee appointed last year to

investigate the underground course taken by streams disappearing into crevices of the limestone in the Ingleborough district will be presented during the meeting, and members will have an opportunity of visiting the site of the experiments. Several papers of value to commercial and industrial men are to be read in the Geographical Section. The president, Sir George Robertson, will address the meeting upon some geographical aspects of the British empire, and he will very probably have something to say with regard to improved means of communication from one part to another.

The lecture intended especially for the working classes is to be delivered by Professor Sylvanus P. Thompson, who has selected the subject of "Electricity in the Industries." Altogether, we believe, the forthcoming meetings of the British Association are certain to prove even more than usually interesting to all who are concerned in practical applications of scientific knowledge.

Electro-Chemistry . . .

For the first time since its birth electro-chemistry is honoured by being treated as worthy of a special "class" in an international exhibition, and it was left to the Commissioners of this year's World's Fair at Paris to declare that this new child of science, one of the latest born in the nineteenth century, has reached the age of maturity, and is fit henceforth to carry on an independent existence. This, however, is merely a kind of semi-official endorsement of a self-evident fact, for the enormous progress made in electrolytic metallurgy alone within the last two or three years has demonstrated very clearly the necessity of treating electro-chemistry as a special science. To those who desire to master fully its constantly increasing number of data, and to devote their time to the solution of its interesting problems, electro-chemistry will leave no time for other scientific work except such as is intimately related to this specialty. There was a discussion some time ago among German authorities on university teaching as to whether or not electro-chemistry should be treated already at the university as an entirely separate branch of study. The question has been negatived, we believe, and justly so, since the university should be the place rather of acquiring a general grasp of the various branches of knowledge, without which special studies would lack a sound basis, than a school for specialists. The entire concentration upon a specialty in the realm of science must be left to the post-graduate period of education. If, however, any specialty requires the fullest devotion to master it, electro-chemistry should be named among the first even at this early period of its life. In the very near future it will offer to the student a very arduous task indeed, though one that will repay the time sacrificed in its performance.

The Proportions of Canals . . .

During recent years experiments have been conducted by French and German engineers with the view of obtaining reliable data as to the ratio which should exist between the cross-section of a canal and that of the vessels intended to be used therein. Some results furnished by experimental tanks in the yards of the Elbe Navigation Company are certainly instructive, and it seems to be clear that the depth of a waterway has some important effect upon the speed of vessels, and consequently upon the power expended in mechanical or other propulsion.

In this connection it may be interesting to recall a letter written in 1798 by Benjamin Franklin to Sir John Pringle. The writer recorded the fact that when travelling by canal in Holland, it was observed that the track-schuit moved in one of the stages at a speed much lower than usual. On inquiring of the boatman what might be the reason, he elicited the reply that the loss of speed was attributable to the lowness of water, which increased the duty required of the horse. This remark caused Franklin to come to the conclusion

that, as the water displaced by the passage of the boat must pass on each side and under her bottom, any considerable reduction of depth would result in retardation, because the water behind the boat would be at a much lower level than the water in front, and backward pressure due to weight would have to be overcome. For the purpose of settling the matter in his own mind, Franklin made a rough experimental tank 14 ft. long by 6 in. wide and 6 in. deep; and arranged it so that the depth of water might be varied at will. He then provided a little boat in form of a lighter, 6 in. long, 2¼ in. wide, and 1¼ in. deep. In order to give motion to the boat a silken thread was attached by one end to the bow of the boat, and the other passed over a brass pulley on the trough, and was connected to a small weight. As the result of many experiments it was found that the speed with 1½ in. of water was fully 20 per cent. less than the speed with 4½ in. of water in the trough. Assuming the establishment of similar results in practice, a somewhat important difference in the cost of propulsion would occur, and as the construction and development of canals are by no means on the wane, the matter is one which may advantageously form the subject of investigation on a large scale.

Another Opening for British Enterprise . . .

In the Amazon district British trade is in a stationary condition, whilst that of the United States and Germany is rapidly advancing.

This is a story we have heard before, and are likely to hear in the future with increasing frequency unless British commercial men awake to a realisation of the new conditions now applying to trade. In a recent report Mr. Temple, Vice-consul at Manaos, especially regrets the lack of British commercial travellers. He remarks that the personal equation is an all-important factor in business transactions in Brazil, and that there is probably no better field for a capable man than in that country. The mere distribution of catalogues is really of very little use, especially in remote parts of the world. German manufacturers are well acquainted with this circumstance, and their travellers are everywhere much more in evidence than our own.

Apart from export business, there is undoubtedly a valuable opening for capital in connection with the rubber trade of the Amazonas. Fully 25,000 tons annually, or about one-half the total production of the world, comes from this district. We do not believe that Great Britain is interested to any special degree in the conduct of this important industry. On the contrary, there is reason to fear that American manufacturers have already secured exceptionally favourable terms for the supply of this material. It is an undoubted fact that in some of our home industries, manufacturers find it preferable to import rubber in various manufactured forms from the United States rather than to buy from British firms, not only because the price is lower, but because the quality is better. This is a matter worthy of inquiry, and some of our energetic readers may find it possible to remove another reproach to British enterprise.

Hand-books of Steel Sections.

If one may judge by appearances, the British steel manufacturer possesses an unconquerable aversion to publicity. We do not mean to imply that he objects to advertising in a modest way, or to issuing circulars and handbooks relative to his goods, but rather that he resolutely abstains from giving such particulars as are essential to the constructional engineer. Let the reader pick up the first publication of this kind which comes to his hand. If he will turn to the part where columns and stanchions are supposed to be described, very little information will be discovered. As a rule, nothing more than some half-dozen crude illustrations of steel columns are given, accompanied by the assurance that estimates will be given. In addition to these unsatisfying generalities, a single page is often devoted to a table of calculated

crushing loads on joists used as stanchions. Some makers seem to recognise the fact that columns cannot fail by crushing, and substitute the more accurate term, breaking loads. But in each case calculations are avowedly based on the assumption that the ends are to be firmly fixed and equally loaded. As these conditions are seldom or never attained in actual practice, it is evident that the tables to which we refer are of somewhat doubtful value. What the constructional engineer requires is a proper sheet of illustrations, and ample details of each stock section. The ultimate strength of the material and the weight per foot, the area of cross-section and the value of r, the least radius of gyration, ought all to be stated. Tables of safe loads might also be given; but, if so, the strains allowed per square inch, the factor of safety, and the formula employed ought to be mentioned, so that calculations could be checked. No practical details of this nature are ever given; consequently the engineer is compelled to design columns and stanchions to suit his requirements instead of using stock sections. Then the manufacturer is apt to bewail the fact that engineers insist upon specifying special sections instead of standard patterns, but he seldom realises that he himself is chiefly to blame. Turning to joists and girders, we find that precise data are omitted from most hand-books. The ultimate strength of the steel, the factor of safety, the moments of inertia and of resistance are rarely quoted. The weights per foot and the nominal dimensions are certainly stated, but not the actual dimensions, nor the sectional area. Instead of proper information, tables of safe dead loads for different spans are furnished, the accuracy of which cannot be gauged because data are not divulged. In some hand-books the loads are calculated on the supposition that the ends of the joists will be firmly fixed, which is a highly improbable, if not impossible condition. Firms who figure out their safe loads in this way doubtless get the reputation of being cheaper than their rivals, who base calculations on the assumption that the ends will be supported in the ordinary manner. Professional engineers can, of course, readily adjust matters of this kind; but steel joists are largely bought by people who may use girders of insufficient strength, because they do not understand subtle technical distinctions. No one seems to know why the average section book is so absurdly incomplete. Perhaps the stock answer of the stolid Britisher may apply, that "it has answered for the last twenty years, and ought to do now." Possibly some manufacturers or merchants fear awkward comparisons would be made if the strength or weakness of their material were known, and if the bases of calculation were no longer wrapped in mystery. However these things may be, it is a fact that very different methods prevail in the United States, where all the leading steel manufacturers and constructional engineers issue most elaborate hand-books, containing such details as are essential. There is no publication of the kind in this country approaching the average American hand-book, although one which is issued by Messrs. Dorman, Long & Co., of Middlesbrough, constitutes a desirable step in the proper direction.

Domestic Electric Supply at High Voltage . . .

It appears that the President of the Board of Trade has not been sufficiently impressed by the deputation which recently waited upon him on behalf of eight metropolitan electric lighting companies in order to convince him of the undesirable necessity for an amendment of the regulations on the change in the pressure of supply to consumers. This is to be regretted, but still more it is to be regretted that any hard and fast rules regarding technical details were fixed by legislation at a time when electricity was as yet, with reference to many questions, in a purely experimental stage. For some time past companies have been engaged in an alteration of their distributing systems in connection with the increase of pressure from 110 to that of 200 volts, by which means the carrying capacity of the mains can be considerably increased and the

laying down of additional distributing cables will not be necessary for many years to come. This alteration is the outcome of new light thrown upon electrical problems by an advance in scientific knowledge, and its advantages could not be foreseen at the time of the hasty legislation referred to. In order, however, to carry it out, thanks to this legislation, the consent of all consumers is required. Well knowing that arguments would be useless with the majority of their clients, who, of course, have not the necessary technical knowledge to judge of the advantages of the change themselves, the companies have pledged themselves not only to undertake at their own expense the cost of altering the wiring and fittings in the houses of consumers so that the higher voltage can be used without the slightest danger, but also to grant a reduction in the price of the electric supplies. This proposal has been accepted by most as satisfactory, but in many cases, perhaps for mere opposition's sake, a number of the consumers refuse to give their consent, and insist on being supplied, as heretofore, at 110 volts. As the companies are legally compelled to supply electricity at this voltage in case the customer demands it, they have for the moment no remedy, and must yield to the unreasonable demand. Few will deny that it is utterly absurd to permit a small minority to dictate to the companies in matters which it requires high technical knowledge to decide, and it is most earnestly to be hoped that the President of the Board of Trade will grant at least the very modest request of the companies for the appointment of an arbitrator, to whom the decision in the dispute should be left.

Commercial "Red Tape" . . .

WITHIN the last year or so references to the methods pursued by Government departments generally, and by the War Office in particular, have been fairly frequent in the columns of our contemporaries. Nor have we hesitated to criticise circumlocutory practices, so far as such have properly come within our own province. No doubt it is a natural tendency of human nature to develop wonderfully complicated mazes of routine for the conduct of public business, and especially when such matters as economy of time and money cease to be essential factors.

But it would be a mistake to imagine that Government departments possess any monopoly in the manufacture and use of "red tape." It is unfortunately the fact that many of our leading industrial concerns are devoting too much attention to this undesirable commodity. We could cite many instances in support of this view, but one will perhaps suffice to demonstrate the contention. In the case selected, a London engineering company, which we will designate as Brown & Co., sent an order to a provincial firm—let us say the "Patent Plating Co." having works in Staffordshire. Owing to some real or imaginary difficulty, this firm is unable to undertake the plating of any metal not rolled at its own works; and Messrs. Brown & Co. have, therefore, been in the habit during the past nine or ten years of first buying certain steel sections from the Patent Plating Company, and afterwards of sending the manufactured parts to Staffordshire for the final operation of plating.

The order to which we refer was addressed to the works, and was for a stated number of stock sections to be delivered immediately. So far everything would appear to be simple; but as week after week passed without delivery of the material, the ordering firm grew increasingly anxious, and as the result of several letters of complaint an explanation of the mystery was at last forthcoming. According to this, it appears to be the rule of the Staffordshire manufacturers that all orders received from the metropolis should be passed through their London office, and as a consequence the original order, sent direct to the works for the purpose of saving an unnecessary delay of three or four days, was posted back to London. In the copy transmitted from the London agent to the works the original terms of the order were entirely misstated, and the principals were told by their agent to

await the receipt of some manufactured goods which would be sent to be plated. The letter of explanation, to which we referred above, went on to state that if it had been known at the works that stock sections only were required, these could have been forwarded promptly.

Here we have people who deliberately frustrate the efforts of their clients to save delays, who refuse to read letters addressed to them, and who run the risk of misunderstandings, simply because of an absurd regulation, worthy only of the "Circumlocution Office" of which Dickens has left us so graphic an account.

Of course it is quite right that London agents should be duly considered and protected; but when a firm is debarred by punctilious scruples from reading and acting upon the orders of regular customers the boundaries of reason are clearly passed. Possibly such individuals are amongst those who most loudly denounce Government departments and their evil habits!

In the name of industrial progress, we ask are practices such as this likely to be perpetrated by our American and German competitors?

Evolution of Steel Making . . .

THE law of the survival of the fittest is inexorable. Our cousins on the other side of the Atlantic have fully grasped this fact, and this is one of the causes of their astonishing success in industrial competition. Alert and of quick intellect by nature, they instantly realise whether a new method or new device represents a striking improvement over older methods, and, if so, they are not deterred by a high price from adopting it, nor do they hesitate to incur the loss resulting from the sacrifice of old plant. What is best, they know, must survive, and to be first in the field and to occupy the best positions, ere Nature's laws compel others to follow suit, repays fully all previous sacrifices. We might learn from them the lesson of anticipating an impending change, or, at all events, of being ready for it. Such a change, of far reaching consequences, is about to take place in one of the most important industries, namely that of steel-making. There are unmistakable signs in the industrial world that the Bessemer process has seen its best days, and that the open-hearth system of steel manufacture will ultimately supersede it. Out of the 26 million tons manufactured in the steel-producing countries of the world, it is true, fully two-thirds are as yet being manufactured by the Bessemer system; but the progress made during the last few years by the open-hearth process has been far more rapid than that of its older rival, and the open-hearth method is being constantly improved, though even in its present condition its superiority is undeniable. These facts in themselves would be a sufficient indication of an approaching change of method, but there are many other signs. It cannot have escaped the notice of those engaged in the iron industry that, for instance, both for structural work and for other purposes, open-hearth steel is much more frequently specified of late than it has been in former years, and that the use of Bessemer steel is being gradually confined within distinct areas. This is not astonishing when one considers that the manufacture of open-hearth steel, provided the work is done on a sufficiently large scale, is even now not more expensive than that of Bessemer steel, and that, according to present indications, it will, in the near future, be considerably reduced in cost. The vital factor, however, in the competition between the two methods of manufacture is that by the open-hearth process a steel of far higher and more reliable quality is obtainable than can be produced by the Bessemer process. The victory of the former, therefore, will not be due to artificial means, but to inherent superiority, and the open-hearth process is predestined to conquer by the law of the survival of the fittest. The sooner this is recognised by makers of steel, the less those of them that use Bessemer plant will lose by the change; nay, if they accommodate themselves to the improved method, they will undoubtedly profit in the end. The real danger for the owners of Bessemer steel works lies in being taken by surprise and being unprepared for the change, which in

that case, no doubt, might result for them in very serious losses. If, on the other hand, they to a certain extent anticipate the new condition of things, the transition need not cause them undue expenditure, even temporarily. Some of the old plant may be advantageously retained, even after adopting the new system. Thus, for instance, the mills that roll Bessemer steel are almost equally well fitted for rolling open-hearth steel; the buildings will require but slight alterations, and even some of the engines, pressure-pumps, and cranes would, no doubt, be still of some service. The only portion of the equipment, therefore, that would become entirely useless would be what may be called the special Bessemer plant. Even this loss, however, should soon be made good through the greater efficiency of the new method, and, on the whole, the general adoption of the open-hearth process promises to be of considerable advantage to the iron industry at large.

The Protection of the Coast Line. . . .

AN article that will be read with interest appears in this issue. It is from the pen of Mr. R. G. Allanson-Winn, and deals with the subject of the protection of foreshores.

That our coast-line is not the same for two consecutive days needs no demonstration. The sea, to say nothing of other physical agencies, is ceaselessly at work, transforming and destroying, jeopardising valuable land, house property, roads, and public works, many of which have been carried out by a large public expenditure.

That branch of civil engineering which is more particularly concerned with foreshore erosion is therefore of prime importance, and the success attaching to the system with which the name of the late Mr. Edward Case is identified goes to prove the soundness of the theory on which it is based, its practical utility and importance.

Public interest is little concerned, unfortunately, with the coast-line, and it is not until some valuable foreshore property is imminently threatened, or that some considerable damage has been done, that an engineer is called in.

The mischief is then probably so considerable that only the expenditure of a large sum of money can save the situation.

Our knowledge of the rates and direction of currents, the velocity of waves, movements and travel of beach, and other factors instrumental in affecting the coast-line, is at present very inexact, and systematic observations taken on these and other material points would enable many catastrophes to be averted.

Mr. Allanson-Winn has been indefatigable in his endeavours to draw public attention to the dangers threatening not only immediate foreshores, but low-lying property far inland, and suggests that the whole question should be dealt with as a national one, and that all shores—with the exception of rock-bound coasts—should be closely watched by a special State department. Such a department would be occupied with (1) the systematic and repeated taking of sections over the same lines on all doubtful shores, as well as contours of high-water, low-water and mean sea-level lines; (2) the taking of soundings; (3) calculations based on observations respecting the varying rates and directions of currents at high water, low water, and mean sea-level; (4) observations as to the velocity and *vis viva* of waves; (5) observations on the travel of beach and other material, especially round headlands, piers, breakwaters, and across bays and estuaries of rivers.

Mr. Allanson-Winn has been in correspondence with the Board of Agriculture on the subject, who suggest that the matter be brought under the notice of the Treasury and the Admiralty.

How such a department should be constituted, and under what control,—lighthouses, coastguard stations, etc., are maintained chiefly at the public expense or by county council and local authorities—is a matter which should not be difficult to determine, and there can be no question that systematic observation and records relating to foreshore protection would not only conduce to a more thorough understanding of the matter, but would result in a large saving.

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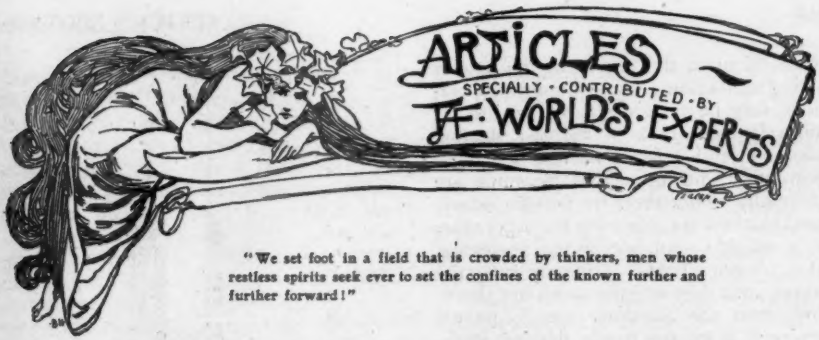
BRIDGE OVER THE SEINE CARRYING THE CHAMP-DE-MARS AND COURCELLES RAILWAY.

From a Photograph specially taken for FEILDEN'S MAGAZINE



"We set foot in a field that is crowded by thinkers, men whose restless spirits seek ever to set the confines of the known further and further forward!"

The Utilisation of Tidal and Wave Action . . . for the Protection of Foreshores.

By R. G. ALLANSON-WINN.

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MR. R. G. ALLANSON-WINN has had considerable experience as a Civil Engineer, devoting his attention more particularly to Foreshore Protection Works. His services in connection with the preservation of road and house property at Glenbeigh from further inroads of the sea were noteworthy. Mr. Winn was also associated in the construction work on the Srinagar-Gilgit Road, and the erection of a large bridge over the Kishenganga River. He had also sole charge of the contract for the Baramoola-Srinagar cart-road, which presented unusual difficulties in construction owing to the numerous waterways intersecting the alignment and frequently flooding the country. Mr. Winn is endeavouring to awaken the interests of the Admiralty and the Board of Trade in the establishment of a special department for making systematic observations and collecting particulars respecting our coastline and the travel of beach and sand.

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WHEN a general principle has been enunciated, whether it be with reference to the application of certain machinery to definite uses, or to some fresh adaptation of Nature's forces to the service of man, we naturally turn to the results of experiments before delivering a verdict. The most novel ideas of the most fertile brain require solid backing up, so that the more searching and extended the experiments the sooner we pass from the realms of theoretical brilliancy to the sober regions of practical application and utility.

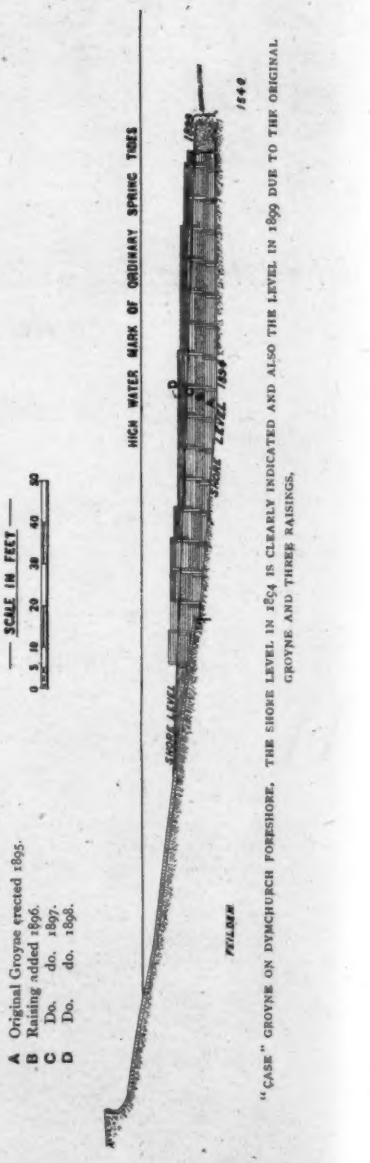
The object of this article is to state shortly the circumstances which led to the discovery, by the late Mr. Edward Case, of a highly scientific system of dealing with sea-coast erosion; to pass on to the actual results which have been obtained by the application of that system to various shores; and to conclude with some remarks on the travel of detritus, a subject of the greatest interest to foreshore engineers, and one upon which there is now no unanimity of opinion.

It is hardly possible to conceive any study more engrossing than that which arises out of a contemplation of sea phenomena; and few who have not given serious attention to the question of foreshore protection works are aware of the complicated nature of the many problems involved. Until comparatively recently but few engineers were to be found who gave very special attention to this particular study; and local authorities and owners considered their knowledge and experience sufficiently extended to enable them to deal, unaided, with the situations as they arose. It is often necessary to call in an engineer to check the encroachment of

the land upon the sea, as in the case of silting up harbours where dredging operations may be necessary; but in the far more frequent case of the sea stealing away our land it is astonishing how often preventive and protective measures are cheerfully undertaken by persons whose qualifications are limited to the occupation of a sea-side residence or the possession of a pleasure boat. Britannia rules the waves until they actually touch her shores and then the positions are frequently reversed, as we see by the flooded lands, eroded cliffs, broken down sea-walls, and silted up harbours, which are to be met with all round the coast.

It is many years since Mr. Case commenced those experiments which were ultimately destined to make his name famous in connection with foreshore protection works. As Expenditor of Romney Marsh he found himself face to face with a problem of great difficulty, viz., the protection of the Dymchurch Sea Wall, upon the integrity of which depends the safety of between 50,000 and 60,000 acres of valuable land. In the early days of the century the wall consisted of a number of earth embankments, erected where breaches had occurred. In 1821 rock was first used to pave the sea slope. This paving was repeatedly extended seaward as the toe became endangered. As time went on various devices for preventing the undermining action of the sea were resorted to. Arming, piling, high groynes, etc., etc., were all tried, but none of them proved efficient, and the constant expense of keeping up and extending the paved apron was a heavy drain on the resources of the Marsh. Over 18,000 superficial yards of paving were torn away in 1859, and, in the 20 years between 1870 and 1890, nearly £70,000 was spent on repairs and general maintenance work. In 1891 no less than 40,000 superficial yards of paving were destroyed, and the damage was continued in 1892 and 1893.

In January, 1894, the Lords of the Level held a special meeting, in consequence of the serious damage effected during that winter. A state of panic existed, and it was feared that, before the termination of the winter, the sea would



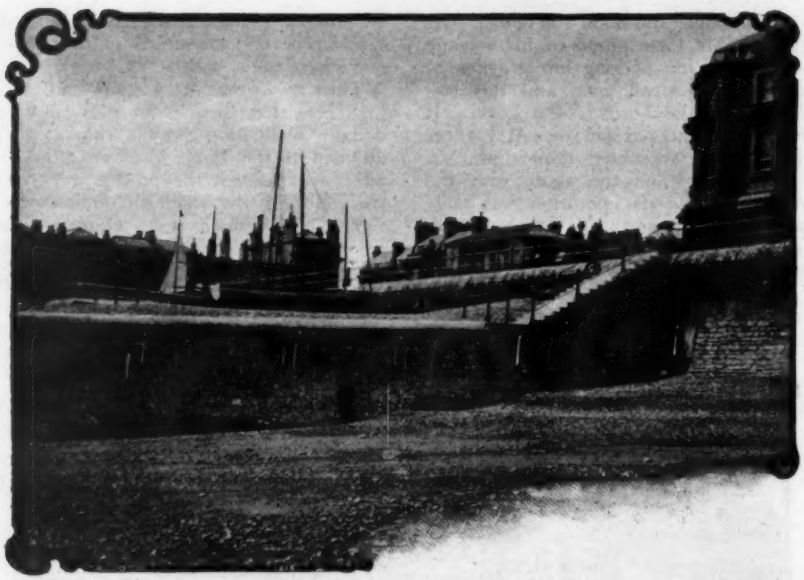
"CASE" GROYNE ON DYMCHURCH FORESHORE. THE SHORE LEVEL IN 1854 IS CLEARLY INDICATED AND ALSO THE LEVEL IN 1899 DUE TO THE ORIGINAL GROYNE AND THREE RAISINGS.

break through and flood the marsh. At this time Mr. Case proposed his scheme for the erection of long low groynes at comparatively small cost, and this was accepted by the Lords of the Level. It must be remembered that since May, 1890, when he was appointed Expenditor, Mr. Case had watched the shore with the greatest care. Its condition was truly deplorable; bars and swills alternated with soft mud and pools of water left by each retreating tide and, worse than all, low-water mark was, at the east end of the wall, quite close to the toe of the stone paving. On making a survey in 1892, it was found that, since the ordnance survey of 1872, the low-water mark had advanced 400 feet at that point, and that deep water was approaching perilously near the last line of defence. The position was critical in the extreme, for it was apparent that, unless the shore material could be secured in such a way as to form a natural protection to the toe of the embankment, nothing, except an expenditure far beyond the means of the Level, could save the situation.

Then it was that Mr. Case promulgated his theory that there is for every shore a certain inclination which, when once attained, is less liable than any other to alteration through the erosive action of the sea. This he called the inclination of repose and defined it as elliptical—the curves varying according to the conditions obtaining on any particular shore. Broadly speaking he came to the conclusion that the sea should not be opposed except by a gradual curve which should offer no abrupt check at any one point.

HASTINGS AND ST. LEONARD'S HIGH WOODEN GROYNE.

The next step was to devise some means of inducing the sea to bring in sand and beach gradually until the shore should lie at the calculated curve. It was found, by observation, that vast quantities of material travelled between mean sea-level and low-water mark, and experiments proved that it was possible, by means of



HASTINGS AND ST. LEONARD'S HIGH MASONRY GROYNE WITH HEAVY ACCUMULATION OF SHINGLE TO WINDWARD AND DEEP SCOUR TO LEEWARD.

very low groynes, running across the shore between these two levels, to divert this travelling detritus inland. In other words, he found that he could arrest and make use of the lateral and material-bearing currents as they pass along the shore with flood and ebb tides.

In order to groyne a shore successfully, adjustment of the planking was an absolute necessity, that the planks must be capable of being easily added or removed as the bars of material are driven inshore by the sea. All the then known methods of constructing groynes were wanting in this respect; and a new method had to be devised. Mr. Case soon overcame the difficulty; and furthermore, by dispensing with the use of a pile-driver or other plant, produced a form of groyne, remarkable for both its utility, economy, and rapidity of construction. Patents were taken out for this and the later variations of design.

The conception of the theory as to the inclination of repose of different shores, and the utilisation of the under-currents for gradually building up the shore from low-water mark, bears the distinct impress of novelty; and the groynes themselves are designed, constructed, and located in a novel manner for a novel purpose. As an instance of novelty of construction it may be mentioned that in 1897 a groyne 650 ft. long, and involving the setting of 88 piles, was erected at Dymchurch in a single tide.

As soon as he had received the authority of the Lords of the Level in 1894, Mr. Case at once set to work, and rapidly put down low groynes all along the Dymchurch shore. Altogether, since 1894, over ten miles of groyning have been put in, some of the groynes being over 1,000 feet in length. The effect of the groynes has been to raise the foreshore in some places as much as 8 ft., and it is computed that along the $3\frac{1}{2}$ miles of foreshore groyned 1,500,000 tons of material have been collected. Sections repeatedly taken during the past two winters prove that the foreshore has assumed the calculated

inclination of repose and is not affected by gales from any quarter.

The *character* of the shore has also undergone a complete and remarkable change. As previously stated, it formerly consisted of running mud and sand, and now it forms a magnificent stretch of hard, well consolidated shingle and sand.

As has been stated* with respect to Dymchurch, "the work will not be complete until the barrier of beach and sand which formerly existed shall have been restored. This is only a question of time, if the work commenced in 1894 be persevered with. A foreshore which took many years to waste away cannot be built up again in four or five years. The foundation of the structure has been laid, and the process of building upon it is progressing as rapidly as can be expected."

It has frequently been urged that though the Case groynes might succeed well enough at Dymchurch, lying, as it does, under the lee of Dungeness Point, they could not be expected to stand in a more exposed situation. The great strength of these groynes lies in the fact that they present very little surface for the power of the water to act against; their work is done gradually, and the plank-by-plank raisings, so easily accomplished, accumulate the shore material, not in heavy isolated accretions, but in evenly deposited layers until the desired surface is reached It is a remarkable fact that not one of the Dymchurch groynes rests on a solid foundation; all the uprights were set in soft mud and sand.

Actual experiment shows that these groynes are suitable to any shore and that they have been eminently successful on shores exposed to the most violent storms, such as Southwold, Deal, Sheringham, Glenbeigh, and Borth in Cardiganshire, all of which places widely differ as regards range of tide and general conditions and circumstances.

* *Vide* "Dymchurch Wall and the Reclamation of Romney Marsh," a paper read before the British Association by Edward Case, 1899.

HASTINGS AND ST. LEONARD'S HIGH MASONRY GROYNE, SHOWING SCOUR ON LEE SIDE AND HEAVY SHINGLE ACCUMULATION ON WINDWARD SIDE.

In different parts of the world shores are composed of travelling materials of various kinds. For example there is the blackish sand of the Gulf of Genoa, the coral grit of the Barbadoes, the caddy (sand) and broken shell of Demerara, and the sand resembling coarse brown sugar of Essequibo, of which I have seen specimens.

Putting aside the question of rock-bound coasts, there are, roughly speaking, three cases to consider:—

1. Beaches where the denudation of shore material is a source of danger to sea-walls, esplanades, and cliffs composed of more or less easily eroded material, *e.g.* Ventnor, Folkestone and the Holderness coast of Yorkshire.

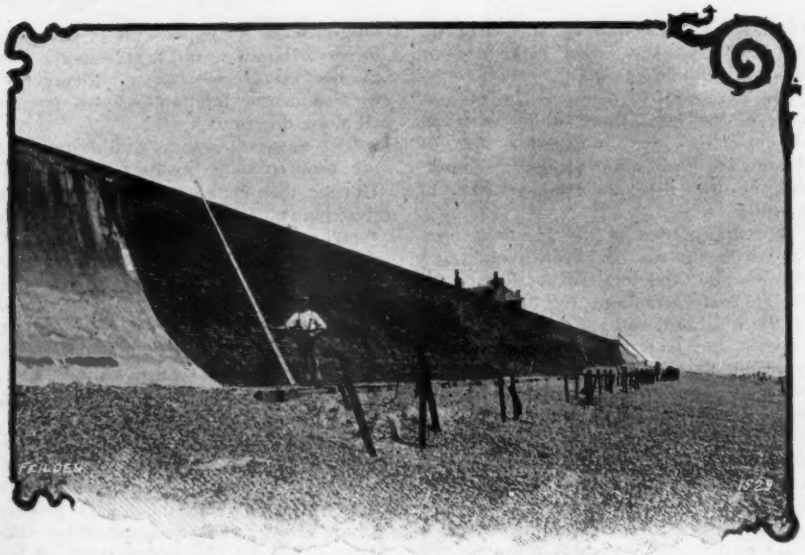
2. Where masses of shingle are being driven inland, as at Aldeburgh.

3. Where shores are so cut about that they consist of bare rocks, pools of water, wet sand and mud, and are not therefore well suited for recreation grounds for children and others, *e.g.* Worthing and Herne Bay.

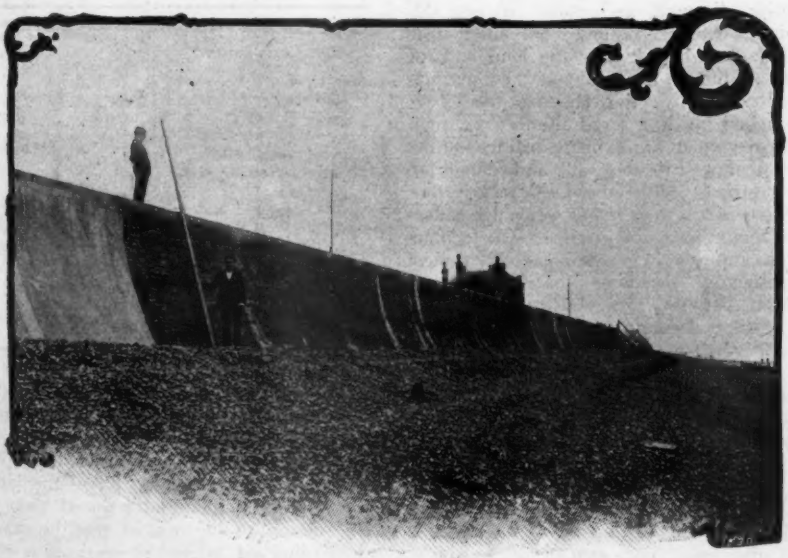
Possibly a fourth may be added, where extensive scours have been caused on the lee sides of high groynes, as at Hastings, St. Leonard's and Brighton; at all of which places a considerable denudation of beach will also be found at the sea ends of most of the high groynes now existing.

It may be safely asserted that the question of dealing with the complicated problems involved in the protection of the foreshores round our coasts is often taken in hand by persons whose only qualifications are ownership of property and residence within sound of the ocean's roar. *Ne sutor supra crepidam.* I may be a very good lawyer, but the fact that my windows overlook a watchmaker's shop does not entitle me to pose as a regulator of chronometers. It would not be reasonable of my laundress to call herself a railway engineer because her drying-ground commands a view of a railway

HASTINGS AND ST. LEONARD'S, GENERAL VIEW OF HIGH GROYNES.



DEAL FORESHORE BEFORE THE ERECTION OF "CASE" GROYNES.



DEAL FORESHORE AFTER THE ERECTION OF "CASE" GROYNES.

cutting. As a laundress she may be unrivalled, but she would make a poor show with the other work.

We have only to compare the present state of the Deal shore, which in 1898 was in a very bad way, with that of Hastings to form some idea of the workings of the new and old systems of groyning.

The appearance of the Hastings foreshore from the sea has been likened to a gigantic saw, the teeth being formed by the alternate accretions and deep scours on the windward and lee sides of the high groynes, and it is almost unnecessary to point out that each and every scour is a point of danger to the integrity of the wall. Then there is the annoyance of not being able to walk along the shore without having to climb up or down a groyne 8 to 12 ft. high, to say nothing of the danger to children.

At Deal, on the other hand, where the Case groynes were erected in the autumn of 1898, there is a fine heavy bank of shingle all the way from the town to Sandown Castle. This bank of shingle has a uniform slope, and lies evenly along the entire distance, and there is not the faintest evidence of any scour either near the esplanade wall or at the land ends of any of the 14 low groynes. To put the matter shortly: the Hastings wall has attached to it a large number of high groynes which are so many distinct sources of weakness to the wall and danger to pedestrians, whilst the Deal wall is protected by a system of groynes which causes no scour, does not interfere with locomotion, and which has brought about most satisfactory results at a comparatively slight cost.

A short account of what has taken place at Sheringham and Beeston, on the Norfolk coast, will be instructive here, for we have evidence of the treatment of three foreshores lying side by side, two of them being successfully treated by the Case system, whilst the third is at present neglected and in an unsatisfactory condition. We may also learn from this example the desirability of dealing with long stretches of the coast line instead of separately treating short isolated portions. If only on the score of expense, it is better for owners to combine and decide upon a plan, the best *modus operandi*, and then get the work done as simultaneously as possible all along the frontage.

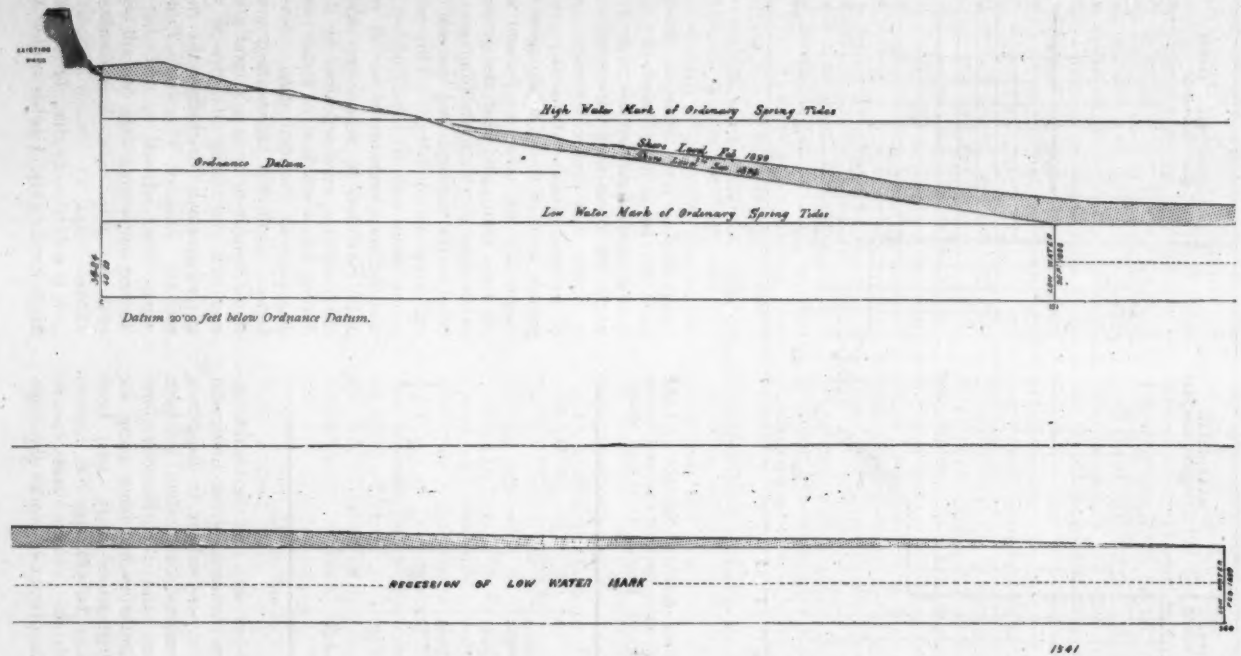
The western foreshore at Sheringham is the property of a private gentleman, Mr. Upcher, then comes the town foreshore in the middle, and then the Beeston foreshore to the east. Both Mr. Upcher's and the Beeston foreshores are protected by accumulations brought up by the Case groynes, but the town foreshore is unprotected, and all along the new sea wall the sea is continually encroaching, until at one place opposite the Crown Hotel there is now (July, 1900) a depth of 6 ft. at high water of ordinary spring tides.

A short glance at the following statements will give a fair idea of the results obtained by means of groyning on the Case system. The tables are prepared from levels and measurements taken periodically for ten months, and are from a thoroughly reliable source:—

Gain and Loss of Shore Material, per 100 ft. frontage, for a distance of 275 ft. from the seawalls, seaward.

	Gain, in Tons.	Loss, in Tons.
Mr. Upcher's Foreshore (protected by Case groynes)	1,050	—
Town Foreshore (unprotected by Case groynes)		
At Coastguard Station ...	—	353
At the West Gangway ...	—	636
At the Crown Hotel ...	—	149
Beeston Foreshore (protected by Case groynes)	1,149	—

In connection with this table it may be noted that a considerable quantity of material has been removed from the shore for the construction of the concrete sea wall; amounting, in the case of the Town frontage, to about 9,000 tons—the latter only refers to material scoured away by the action of the sea, so that the actual loss obtained by record sections is very considerably greater than that tabulated.


High Water Mark of Ordinary Spring Tides
Ordnance Datum
Low Water Mark of Ordinary Spring Tides
Datum 20·00 feet below Ordnance Datum.
RECESSION OF LOW WATER MARK
1341

DEAL SECTION; SHOWING IMPROVEMENT BETWEEN SEPT. 1898, AND FEB. 1899

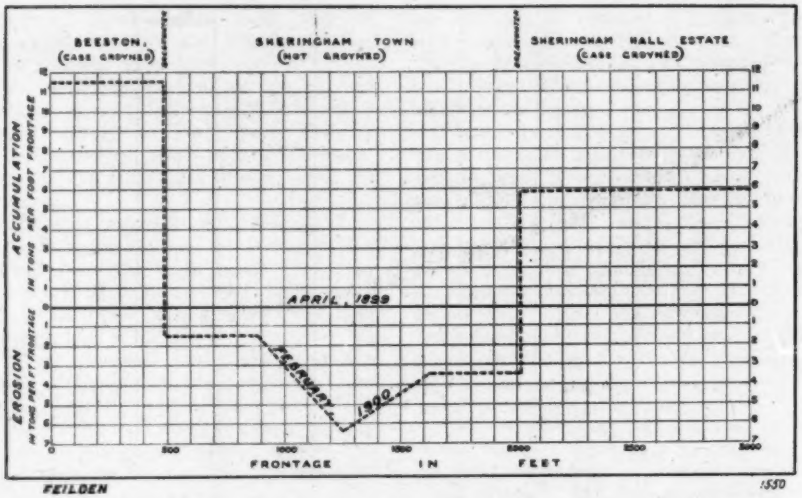


DIAGRAM OF SHERINGHAM AND BEESTON FORESHORE: SHOWING ACCUMULATION AND EROSION.

Average Distance, from the Seawalls or Cliff, of the high-water mark of Ordinary Spring Tides, showing Encroachment and Recession.

	Ap. 25, 1899.	Feb. 19, 1900.	Encroachment.	Recession.
At 400 ft. to west of Mr. Upcher's groynes	—	42	—	—
At Mr. Upcher's Foreshore	*46	70	—	24
At Coastguard Statn.	43	33	10	—
At the West Gangway	30	4½	23½	—
At Crown Hotel ...	4 ft. 6 in.	depth of	water	
At the Beeston Foreshore...	21	25	—	4
At 400 ft. east of the Beeston groynes ...	—	18	—	—

* On April 8th, 1898.

It will thus be seen that the town frontage has been considerably scoured, and that the new sea wall is in danger of being undermined, but that at both Mr. Upcher's and the Beeston foreshores accumulation has been going on, and that high-water mark has been driven back. It will also be noticed that at both the western and eastern limits of the protective works the high-water marks come closer in shore. It must not be supposed that the wasting of the town foreshore is due to any single set of adverse circumstances; it is simply due to the continual process of erosion which we notice on the greater part of the Norfolk coast where means are not taken to prevent it. It has been contended that the groynes on either side of the town frontage contribute to the erosion and prevent material from accumulating. This is quite an erroneous view to take, the fact being that the town foreshore is not at present in a condition to retain any material; if any material were deposited by the sea during calm weather it would speedily disappear in the first gale. No satisfactory result will be obtained until the shore is made to lie at a natural gradient, and this can easily be arrived at by groyning, which Mr. Jaffrey, the engineer for the District Councils' Protection works, has advised should be done. The accompanying diagram will serve to indicate, graphically, the condition of affairs.

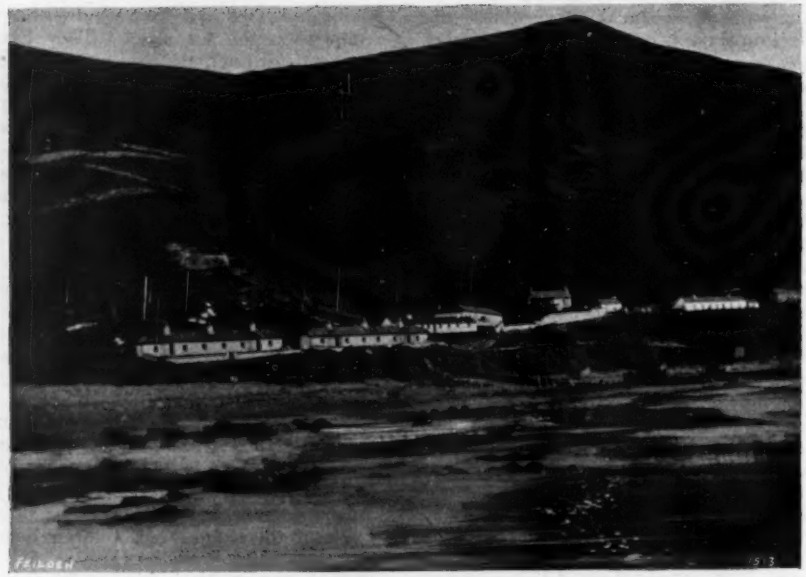
It is well to note that the Sheringham Hall Estate (Mr. Upcher's) lies to the

windward of a breakwater, whilst the Beeston shore is on the lee side of another breakwater, and that the improvement has been equally manifest in both cases.

I may here point out that the action of the Case groynes is so unobstructive, and there is such a complete absence of scour, that the shores of adjacent owners are never damaged through their erection. An excellent example of the contrary is shown at Hythe and Sandgate, where the high boundary groyne between the Seabrook sea wall and the Sandgate Esplanade has caused a deep scour on the lee-side, into which the sea rushed last year, doing considerable damage to the road and tram lines. Here we see that the protection offered to the Seabrook wall owners is an imminent source of danger and loss to the Sandgate owners; and the legal axiom that "you may not protect your own property, if in so doing you damage your neighbour's," seems more honoured in the breach than in the observance. I could give many other instances of similar damage by high groynes, but pick out Sandgate because it is an excellent example, and can be readily inspected, as it is but a short walk from either Hythe or Sandgate railway stations.

In 1897, before I was acquainted with the Case system, I was called in to advise on the treatment of the Glenbeigh foreshore, and more especially on the protection of one particular point at which the sea threatened the rapid destruction of a road and some houses standing on the cliffs overlooking the shore. The position was critical, and as the owners of the estate were not able to afford a sea wall of adequate strength, the cost of which I estimated at £25,000, I decided to erect three heavy slanting timber groynes on the old principle—*i.e.* at and above high-water mark, and pile-driven, with horizontal timbers and supports. These groynes, which, as will be seen on reference to the accompanying rough plan, were constructed so as to form an obtuse angle with the prevalent westerly winds, were completed in 1898, and, up to now, have in a measure protected the road and houses, and have collected a considerable quantity of heavy shingle which has been washed over from windward and retained on the lee sides. They have apparently arrested the travel of a certain amount of shingle, and probably, to some extent, diverted the lateral currents away from the threatened portion of the cliffs; but one cannot get away from the fact that such solid structures, though they only stand from 2 ft. 6 ins. to 4ft. 6 ins. above the shore level, at and above high-water mark, must cause a scour, and it is quite evident that the sea, checked temporarily at one point, is bound to encroach on either side of that point. I may here mention that on my return from abroad in 1896 I found that two high groynes had been put in at right angles to the line of high-water mark, and close to where I ultimately erected my three slanting groynes. In each case these groynes, which were carried right up to the cliff, had led to the formation of distinct bays or scooped-out hollows on both sides, similar to the scooped-out hollow at Sandgate, near the boundary groyne above alluded to, and this led me to adopt the slanting form of high groyne as less likely to promote the propulsion of heavy volumes of water against the cliffs.

In the Spring of 1899, at my suggestion, the late Mr. Case was called in to advise. I had carefully gone into his system, and had seen for myself the remarkable results achieved by its application at Dymchurch and Southwold, shores of very different character. Mr. Case was of opinion that, though rather late in the day, protective measures should be at once taken if the land to the east of the spit of sandhills running north and south was to be saved, and advised the erection of nine groynes. These were erected last Autumn, since when they have worked well, bringing in large quantities of shore material which would otherwise have been swept away. The gradient of the shore has vastly improved, we have accumulated, for the first time in my recollection, thirty-five years, material all through the winter months, until we have now many thousands of tons of shingle and sand banked up where there were formerly pools of water left by the retreating tide or long stretches of bare,



GLENBEIGH FORESHORE, 1898, SHOWING DENUDED CONDITION OF SHORE BEFORE THE ERECTION OF GROYNES. THE EXPOSED ROCKS ARE NOW COVERED WITH SAND.

GLENBEIGH FORESHORE. PILE-DRIVEN GROYNES IN COURSE OF ERECTION.

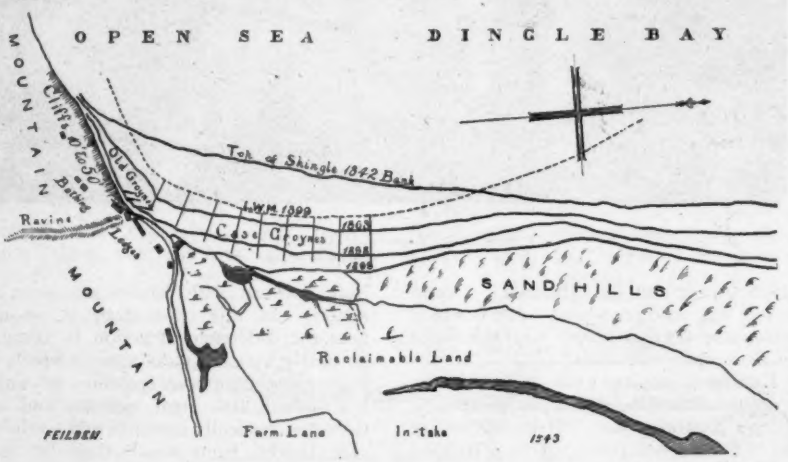
exposed rocks. There is at Glenbeigh an 11-ft. range of tide, and a heavy travel of detritus in the form of old red sandstone (the formation of the district), green boulder fragments, and sand. The shore is on the south coast of Dingle Bay, co. Kerry, and is exposed to west and north-westerly gales; and there are strong lateral currents with the flood and ebb tides which have always scoured away both sand and shingle in the winter time.

In connection with this system of groyning, the question is frequently asked: "How long will it take to bring up the material required to produce the desired surface laid down as necessary?" So much depends upon the amount of travelling material afforded by the district, the direction of currents, and the direction, duration, and intensity of storms—which are, of course, impossible to predict—that it is necessary to be guarded against raising false hopes by stating *definitely* that such and such results will be brought about by a certain date. The late Mr. Case's opinion was that in most cases it would take three years, provided no structures were allowed to remain which offered obstruction to the natural flow of the sea. In any case, given travelling material and a sufficient amount of wave-power, a shore can be built up—more or less rapidly according to circumstances—so as to take and maintain that form which will be least liable to alteration.

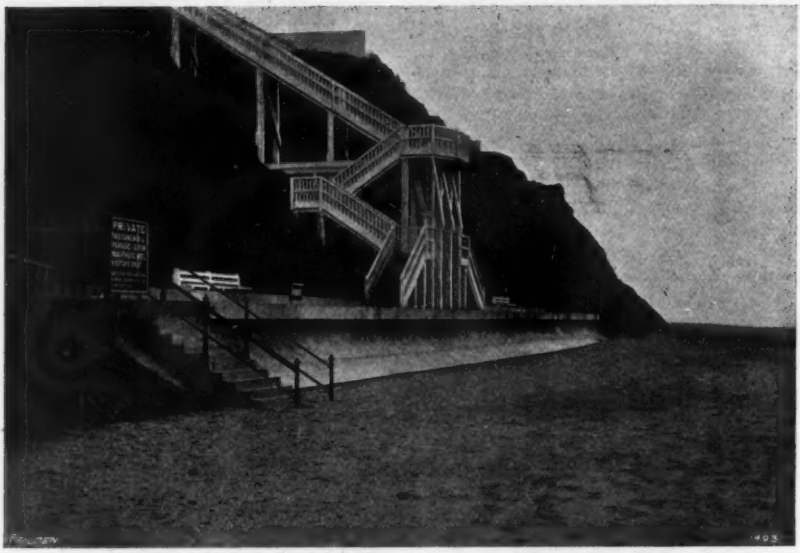
We are able to point to the many hundreds of thousands of tons of material accumulated entirely through the agency of the Case groynes, and can also show places where the work has been completed, and the shore has assumed the required curve, and the surface is not damaged or altered by the severest storms.

At first sight it seems impossible that these light structures, or "accumulators," as they have been termed, could do much good, yet it is an indisputable fact that they have been instrumental in collecting vast masses of sand and shingle which might otherwise have been lost to the particular shores on which they have been erected.

As regards the time the timber itself will last it must be remembered that, being situated between mean sea level and low-water mark, these groynes become saturated with water. Being perpetually wet they will have a longer life than the high groynes, which are alternately wet and dry—the most rotting conditions to



GLENBEIGH FORESHORE. PLAN.



MUNDESLEY FORESHORE AND WALL.

which timber can be subjected. I have myself dug up quite sound timbers which must have been saturated with salt water for close upon 100 years.

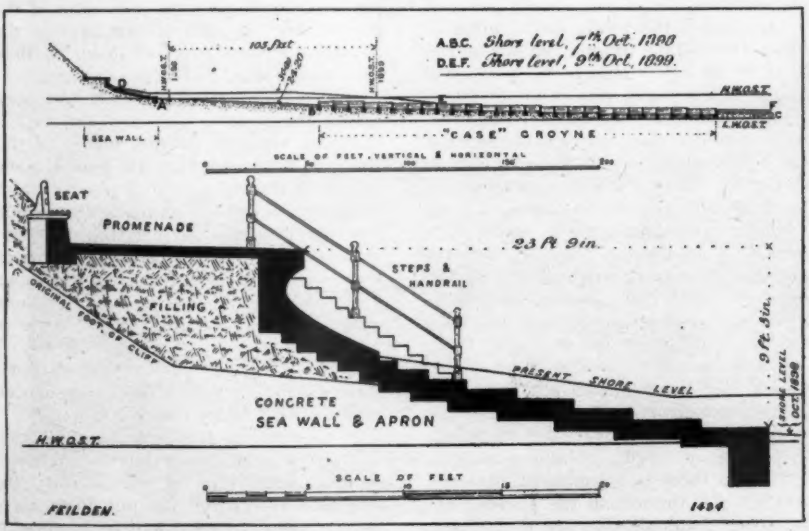
Excellent results have followed the adoption of the Case system at Mundesley, on the Norfolk coast. Here the toe of the cliff has been protected by a stepped concrete wall, of a form consonant with the Case system, and the adjoining foreshore has been groyned. The cliff has been sloped off to meet the inner wall of the esplanade, and the groynes have been the means of accumulating shore material which satisfactorily protects the toe of the wall. This form of wall which is shown in the section, though of comparatively light construction, is ample for its purpose. Where the Case groynes are employed an inexpensive wall is sufficient, as the gradual curve of the shore from the top of the full down to the low-water mark prevents the occurrence of any heavy breaking waves on the wall itself, the surface water, during storms, merely splashing harmlessly against the curve of the wall face and being thrown back seaward with hardly any scouring action. In this connection we should note the difference of action in vertical, or nearly vertical, walls against which, at high tides, enormous volumes of water are dashed with great violence and are deflected vertically upwards to a considerable height, from which they fall and scour the shore material away from the very place where it is most needed—the toe of the wall. This scouring action may be observed at places where high groynes have caused scours on their lee sides close up to the walls. In a storm, with wind on shore and a high tide, the heavy waves hurl themselves into these pockets with terrific force, carrying up shingle which, falling back, adds to the mischief already effected by the scouring-out action on the lee sides of the groynes.

Turning to the west coast of England we notice that some very satisfactory work has been carried out at Blackpool, where, needless to say, there are many important interests to protect. Here there is a range of tide of 27½ ft., and the westerly and

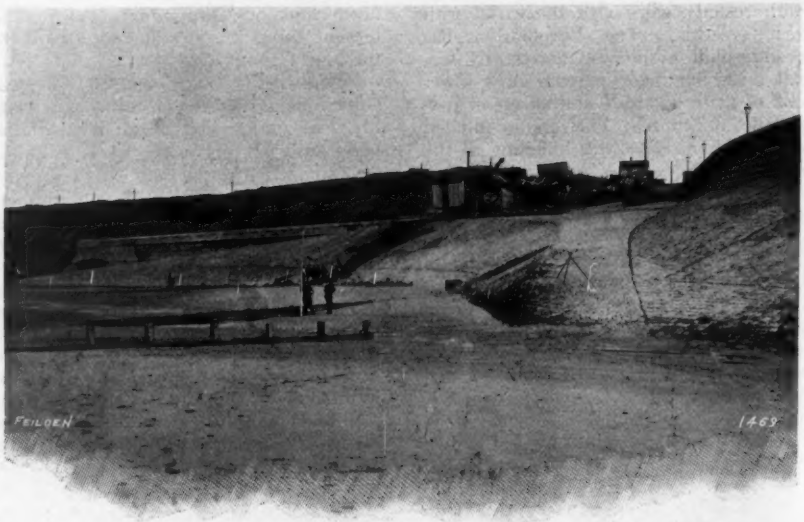
south-westerly gales visit the coast with great severity. The Corporation has recently built a splendid and costly sea-wall, on which there is room for a lower walk of 15 ft. in width, and an upper promenade of 50 ft. The granite-pitched wall, which receives the buffeting of the waves at high water, is sloped at an angle of 2 to 1, and the lower walk is 12 ft. above the level of the highest Spring tides. To the north of the Blackpool Corporation Wall come the cliffs of the Gynn Estate Company, and I am informed by Mr. Arthur Hindle, Assoc.M.Inst.C.E., that here the sea has made very serious encroachments during the past fifty years, in which time it has been estimated that the advance has been over 150 yds. Foreshore protection work was commenced here in September, 1898, when five groynes, each 1,000 ft. long, commencing at mean sea level and 380 ft. apart, were put down opposite the Gynn Estate. A little more than a year afterwards, in October, 1899, four groynes, three of them 1,000 ft. long and the fourth 1,200 ft. long, were put down opposite the north end of Corporation Wall. The section shows the accumulation close to the long 1,200-ft. groyne.

About two years ago the Belgian Government, after consulting the late Mr. Case, adopted the system at Mariakerke and Middelkerke, two towns near Ostend. At Mariakerke five groynes were commenced in the autumn of 1898, the total length of the groynes being 1,150 metres, and the frontage protected extending for over 600 metres. The work was commenced in September, 1898, and the total length of groyning completed this spring. Notwithstanding the short time the groynes have had to work, the Mariakerke shore now shows a very fine stretch of hard, dry sand, the whole area involved being practically free from swills and pools of water. It is hardly possible now to find any really wet spots on the shore at low water, and at high tides the sea rarely touches the wall.

Similar improvement is noticeable at Middelkerke, where there are three groynes of a total length of 825 metres,



MUNDESLEY. SECTION OF WALL, ESPECIALLY DESIGNED FOR USE WITH "CASE" GROYNES. THE LATTER ARE INDICATED ON THE SMALL SCALE SECTION.



BLACKPOOL, LANCS., AFTER THE ERECTION OF "CASE" GROYNES.

protecting a frontage of 300 metres. In this instance one of the chief objects of the groynes is the protection of a double slipway projecting beyond the face of the digue or seawall. It may be mentioned that at these places the range of tide is 15 feet, and that the shores consist entirely of sand. A reference to the sections will be sufficient to show the manner in which the toe of the wall is protected by the newly-acquired accumulation of sand.

Till quite recently there might have been seen at Preston (Dorset), near the Coastguard Station, a typical hog backed high groyne. This groyne, like many others still in existence round the coast, had been designed so that the upper timbers followed a curve *to which it was desired and hoped the section of the "full" would approximate*, and, had the beach so formed up, there would indeed have been a magnificent result. Unfortunately, in such cases there is no magical attraction between the timbers of the groynes and the shore materials they are designed to accumulate, and the invariable result is a scouring away of beach or sand on one or both sides of the structures. At Preston the scour took place on both sides of the groyne, and to such an extent that the heavy piles were exposed down to their very shoe points, and were supported only by the additional piles which had been driven alongside!

When engaged in the survey of this shore in April and May last year, I could not ascertain the actual depth to which these piles had been originally driven, but, from the length of the piles and the heavy scantling, they could hardly have been driven less than five feet into the shore, and this serious scooping out of shore material had taken place in the course of a very few years.

It may be added that a scheme of thirty Case groynes has just been commenced here for the County Council.

A reference to the Dymchurch section will give a good idea of how the "raising" is managed. First of all, in 1895, the original Case groyne was put down, then, as the sand accumulated, fresh uprights and planks were added, until, to-day, we have the fine even-sloping shore shown by

the thick upper line. The old piling at the foot of the wall has long since disappeared beneath the sand, and the paving is so well covered that it is practically safe in even the severest storms.

The Deal photographs and section show how the toe of the wall there has been protected by the Case system, and how vastly improved has the general condition of the shore become *in the course of only one year*. Similar photographs and sections of Southwold and many other places could be given, showing equally remarkable and satisfactory results, but the length of this article precludes the multiplication of examples. There is no wide difference between the conditions obtaining at Hastings and Deal, and I would invite comparison between the shingle beaches of the two places as shown by the photographs.

Before concluding my description of the Case system and its working, I will quote what Mr. Gray says as to its relation to the Case groyne:—"The success of the Case groyne is not due so much to its peculiar construction as to the principles of the system to which it belongs. The Case groyne cannot be separated from the Case system: it is efficacious when used in conjunction with that system, and not otherwise. It fulfils the requirements of that system, as no other known groyne possibly can. But in procuring successful results it is only instrumental: both the creation and existence of those results are due to the principles by which the future inclination of the foreshore is determined, and by which the groynes are designed."*

There are two ways of proving the travel of beach and other shore material; one is by picking up specimens on the shore and comparing them with the local formation and deposited material, and the other is by dredging along the coast line in various depths of water and examining the material for any signs of attrition or abrasion which would give evidence of motion. Local objectors will insist that there is either "no sand" or "no shingle," or that

* "The Solution of the Problem of Sea Defence," 1898 ed., p. 19, by F. J. Gray, Assoc. M. Inst. C.E., F.R.Met.Soc., F.R.G.S.

BLACKPOOL, LANCS.: BEFORE ERECTION OF "CASE" GROYNES.

"shingle never travels at or near low-water mark," and occasionally fishermen have denied the existence of sand or beach because they have not found it in their lobster pots. It was the late Mr. Case's opinion there is always material travelling along the coast or held in suspension.

Off a sandy shore a bucketful of water, taken during rough weather, will give a heavy deposit of that material; and although travelling material may never have been known to accumulate permanently on a particular shore, it by no means follows, if the forces of Nature are properly utilised, it is an impossibility, or that a protective shore cannot be built up equal to that at Dymchurch.

Whenever the sea is discoloured, even in comparatively fine weather, as it is all down the Holderness coast of Yorkshire, where the discolouration is of a chocolate hue; off the Dover coast, where the milky appearance evidences the chalk formation; or off the Lincolnshire or Norfolk coasts, where the yellow tint plainly indicates sand, we know that particles of matter are there held in suspension to be ultimately deposited *somewhere;* and, though this material may never have been collected to the advantage of a particular shore, much of it may be so collected if the proper means are employed. The discoloured upper portions of water which we see are not so heavily laden with material as the lower currents, and it is the lower—material-bearing—currents which are directed shorewards by the Case groynes.

At certain places—notably Yorkshire—the discolouration is very marked, and in other localities there is not much to see; but, whether reference is made to the granite of Aberdeen, the hard rocks of Portland and Plymouth, or the soft red mud of Holderness, the process of denudation is for ever going on and the material, whether it gets into shallow or deep water, is constantly kept moving by the action of ocean currents or waves. There is always a travel of detritus—the quantity and rapidity are merely questions of degree.

Now, as regards the travel of beach and the depth of water in which it may be moved, either by wave action or the action of currents, the experiments of scientific men have led to the expression of such widely different views and conclusions that I feel some diffidence in expressing any very decided opinion until the investigations on which I am now engaged have reached a more advanced stage.

To my mind, the most satisfactory method of getting fair and indisputable evidence is the actual taking up specimens from the bottom of the sea, and to do this rapidly and effectively I have designed a prospecting grab, which is portable, and fits into a box, and can be carried almost as easily as one's theodolite or dumpy-level. The length of this article will not admit of my giving a full description of the apparatus, which, like most other grabs, consists of two equal and similar cheeks, which automatically close when bottom is reached. Some advantages I claim for this grab are: Lightness, simplicity, absence of all levers, pulleys, and wheels; certainty of action; ease with which repairs can be effected (it is worked with a single rope, on which the fathoms are marked); ease with which it can be ballasted to suit the work it is required to do. When used for prospecting, the disc which first touches bottom is smeared with tallow or some other adhesive substance, after the manner of sounding-leads, for the purpose of collecting fine particles which might possibly escape through the teeth in drawing the instrument up through many fathoms of water. This grab, which, for prospecting purposes, may be cut from a hollow cylinder of copper or iron 18 ins. in diameter, can also be used on a large scale for dredging up sand or other soft material.

In support of my statement as to the diversity of opinions existing amongst the authorities, I will quote a few extracts which were collected by Mr. A. R. Hunt.*

Sir John Coode was of opinion that "shingle accumulates upon any beach with off-shore winds, whilst it is carried off, or scoured away, during on-shore winds, and more especially by the ground-swell which follows." Mr. G. H. Kina-

* The Scientific Proceedings of the Royal Dublin Society, January 7th, 1885.

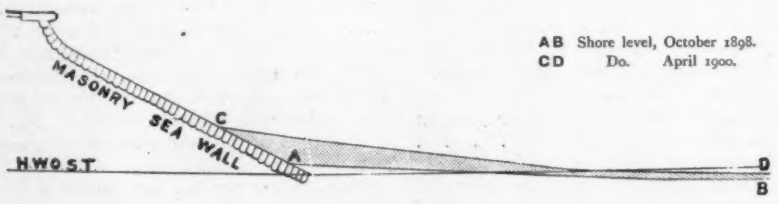
han, writing of the east coast of Ireland, between Carnsore and Dalkey, says: "West and south-westerly winds (*i.e.* off-shore winds) generate ground-swells, which usually cut out the beaches. . . . . Ground-swells with east winds (*i.e.* on-shore winds) sometimes seem to assist in filling in the beaches, but with north-easterly winds they cut out."

Sir Geo. Airy held that "the progression in smallness of the pebbles pointed to the direction from which the current or fluctuation must have transported them . . . they must have been transported from the end of the bank, where they were large, towards the end where they were small"; and

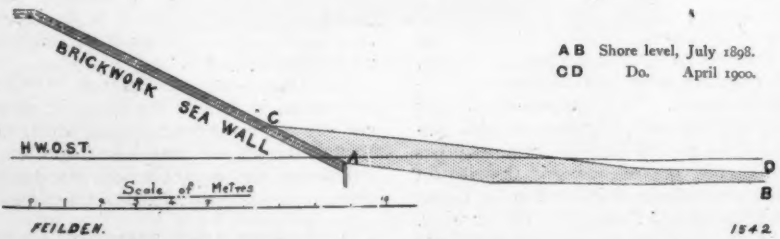
Admiral Spratt on one occasion put overboard five bags of clinkers, weighing from 3 lbs., 4 lbs., and 5 lbs. to a few ounces, and on visiting the spot a fortnight afterwards to examine the effect of wave action, he found at 450 yds. to the leeward the largest pieces of clinker nearest the point of starting, one weighing 3½ lbs. and the other 2 lbs.; at 700 yds. and 800 yds. they weighed less than 1 lb.; and at 1,500 yds. and 1,600 yds. from ½ oz. to ¼ oz. only. Thus the heaviest and largest pieces did not travel the farthest, but the contrary.

In opposition to these last two authorities, Sir John Coode was of opinion that "the cause of the large shingle being found at what is called 'to leeward' upon any beach, is due to the fact of the large pebbles moving more readily than the small." In this he backed up by Mr. Redman, who says, "Undoubtedly the largest shingle travelled to leeward." Then Mr. T. Mellard Reade says: "It was not, as Sir John Coode supposed, that the large stones were the more easily moved, for the reverse could be readily proved . . . . the large stones, in fact, travelled up a lesser gradient, and consequently to a greater distance."

Sir A. Geikie held that, "A prevalent wind, by creating a current in a given direction, or a strong tidal current setting along a coast-line, will cause the shingle to travel coastwise, the stones getting more and more rounded and reduced in size as they recede from their sources. The Chesil Bank, which runs as a natural breakwater 16 miles long, connecting the



MARIAKERKE, BELGIUM.



MIDDELKERKE, BELGIUM.

Isle of Portland with the mainland of Dorsetshire, consists of rounded shingle, which is constantly being driven westward."

Sir Chas. Lyell, on the other hand, "admitted the apparent paradox of the largest pebbles at the Chesil Bank being found to leeward, or farthest from the source whence they were derived, as he took it for granted that they did come from the westward . . . . throughout the Chesil Bank the pebbles increase gradually in size as we proceed southeastward, or as we go farther from the quarter which supplied them."

Thus we fail to come across many traces of unanimity amongst these writers, even on this question of beach formation and the travel of large and small specimens; and when it comes to the *depth* at which shingle travels, we also find startling discrepancies or differences of opinion upon what one would think should be matters of fact.

For instance, Mr. J. M. Rendel's opinion was "That shingle could scarcely be moved, by the heaviest waves, at greater depths than three fathoms." Sir E. Belcher said that "The waves during heavy gales exercised power at very great depths; he had seen evidences of it in water fourteen fathoms deep. He thought the tide current did not affect depths of more than 12 or 14 ft." Against this, again, there is the opinion of Mr. Joseph Gibbs, who considered that " . . . . the movement of the beach in question was not so much due to the ordinary flow as to what might be termed submarine currents, which had the power of carrying pebbles along the shore at great depths, until the waves cast them up as shingle."

As far as my own observation has at present extended, I have noticed that most shores have their distinctive shingle, and that this is mainly composed of the rock formation of the neighbourhood, or of already abraded fragments of rock embedded in the alluvial or otherwise deposited soil of the locality, though on nearly every shore there are to be found some specimens foreign to the locality. Thus we find on the shores of Dingle Bay, in Kerry, a great preponderance of old red sandstone shingle, the outcrop of rock all along the foreshore for many miles being old red sandstone, with occasional breaks of slate. There will, however, be found a small percentage of green boulder fragments—green boulders of all sizes, relics of the glacial period, are to be found embedded in the mountains which fringe the shore. Probably there is not more than 5 per cent. of material other than old red sandstone on this shore.

The gravel flints to be found between Sandgate and Dungeness are very much in evidence all along that coast-line, though there is a distinct percentage of other shingle. Heavy black chalk flints larger than cricket balls have been pointed out to me at low-water mark on the Dymchurch shore. These chalk flints were thus found in the middle of a gravel flint district, and their state of attrition indicated a great deal of travelling and knocking about. In any case, they must have come from a considerable distance, as there is no formation at Dymchurch from which they could have been derived.

Mr. R. A. C. Austin has remarked that "Along our own southern coasts the movement of shingle is from west to east, and on the opposite coast of France it is the same. On the Chesil beach may be collected pebbles of limestone, greenstone, trap, and old red sandstone, derived from the older rocks of South Devon." Mr. F. Wynne was of opinion that the occurrence of any sort of rock as a pebble on the Chesil beach proves the existence of a more or less exposed reef of that rock between the commencement of the shallow water of the Channel and this beach; and he further held that "if syenite* was found, then syenite existed in the bed of the Channel, perhaps as far as the entrance of the Bay of Biscay."

Mr. Case's opinion was that "wherever there is deep water close in shore, and the coast is not precipitous and rock-bound, shingle will always be found."†

Possibly the greater weight of scientific opinion is in favour of beach travelling in

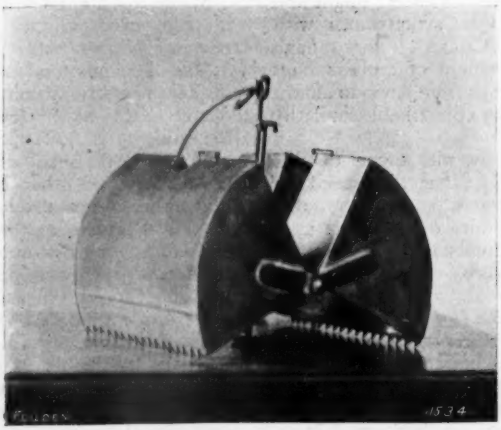
* A rock composed of quartz, hornblende, and mica, from Syene, in Egypt, where it abounds.

† The Dymchurch Wall.

water of considerable depth; but whether this travel is due to the action of waves or of tidal currents, or to a combination of both, is a question it may take some time to answer with any degree of certainty. When, however, we come to the steady advance of Dungeness Point towards the French coast, we are not dealing with a matter of opinion but a matter of fact; and as the advance is steadily made into deep water—100 ft. and more—and the material so advanced is entirely shingle, we are almost forced to the conclusion that shingle does travel in water up to 16 or 17 fathoms in depth.

[I am indebted to Messrs. Case and Gray, for the drawings and photographs which they have kindly lent me to illustrate this article]

R. G. Allanson-Winn.



PROSPECTING GRAB, DESIGNED BY MR. ALLANSON-WINN.

Fast Cruisers.

By CHAS. E. CANNING.

MR. CHAS. E. CANNING was born in 1875. He received the technical portion of his education at Rutherford College, Newcastle, and with the firm to which he was apprenticed as Ship's Draughtsman in 1888, namely Messrs. Wigham, Richardson & Co., Newcastle, with whom he remained until 1895. Since that date he has served with the Naval Construction and Armaments Co., Ltd., Barrow-in-Furness, and Messrs. W. G. Armstrong, Whitworth & Co., Ltd., in which latter firm he was second in charge of the Naval Division of the Drawing Office.

In 1899 he took up his present position as Naval Ship Constructor with Messrs. Burmeister & Wains, Copenhagen.

Mr. Canning is a member of the North East Coast Institution of Engineers and Shipbuilders.

THE term "Fast Cruisers" might well be said to be synonymous with "Modern Cruisers," for though the displacement of cruisers built in recent years varies from 2,000 to almost 15,000 tons, there is a remarkable similarity in their speeds.

Indeed we can say, with a considerable degree of accuracy, that the speed of modern cruisers varies between the comparatively small limits of 20 knots as a minimum and 23 knots as a maximum.

Only in exceptional cases have higher speeds been reached.

This points to the fact that builders of cruisers in all nations, while differing materially as to the correct ratio between offensive and defensive properties, coal-carrying capacity, weight of hull to total weight, etc., are agreed that speed is an absolute essential.

While the English army officials have (as the beginning of the war in South Africa proved) been slow to recognise that great mobility goes far towards ensuring success in military operations, their brothers in command of naval matters have long recognised the supreme importance of speed in cruisers and all smaller craft.

While this applies to the English navy, it applies every whit as much to foreign navies.

The general tendency toward huge displacements is attributable in no small degree to this striving after high speeds; for while it is quite possible to obtain such speed on small displacements, it is at the cost of other qualities, such as protection, comparatively small armament, or others which go towards making an efficient fighting machine.

Of course it must not be understood that high-speed cruisers of the smaller types are not needed; for, although not adapted to act as independent units, they are invaluable as "the eyes of a fleet" or as commerce destroyers.

In these ways they find a place in the economy of large and small navies alike.

The desire to produce vessels which answer these purposes, and are at the same time able to act independently, has resulted in such gigantic vessels as H.M.S. *Powerful* and *Terrible* in our own navy; the French *Jean d'Arc*, and the Russian *Rossia*; but it may be justly said that such ships have almost as much right to be classed with battleships as with cruisers.

The writer of this article intends dealing rather with smaller cruisers than with such vessels.

As the subject is to be dealt with purely from a shipbuilder's point of view, it may be as well at the outset to acknowledge the splendid work of marine engineers, who, with the advent of water-tube boilers and more perfect engines, have enabled the shipbuilder to calculate on 11½ i.h.p. for every ton of machinery put on board.

Without that, and without Harveyised and Krupp nickel-steel armour plates having a resisting power equal to twice their thickness of wrought iron, the shipbuilder would not have the remotest chance of producing the modern cruiser.

It would serve no good purpose to discuss the form of these vessels, as builders and navies have distinctive features of their own, for most of which they have good reasons.

At the same time, while ships have very different appearances in different navies, an examination of the underwater portion of the hull shows no very startling differences.

Only in the amount of "cut away" forward and aft do we find any great discrepancies.

Therefore, we proceed at once to the consideration of scantlings and disposition of material.

It is impossible to study, even superficially, the disposition of material in a cruiser, without at once coming to the conclusion that, on the whole, it is much superior to the mercantile marine practice, and this notwithstanding the fact that in such vessels much of the material has an arbitrary position very greatly against a perfect structural arrangement.

For example, a very heavy stem casting, with its attendant thickening of shell-plating, etc., for ramming purposes, must be fitted.

This is of no structural value whatever.

Again, the protective deck must have, relatively, a vast weight put into it, although it is necessarily placed at a point so near the "neutral axis" of the vessel, as to make the "equivalent girder" very far from a perfect one. And these instances are not by any means isolated ones.

At the same time it would be unfair to our mercantile shipbuilders not to recognise that the conditions are not all in favour of the merchant ships, for with them cost is a primary factor, and therefore they cannot adopt the elaborate system of longitudinal framing in vogue with builders of war vessels, and indicated on the scantling sections illustrated.

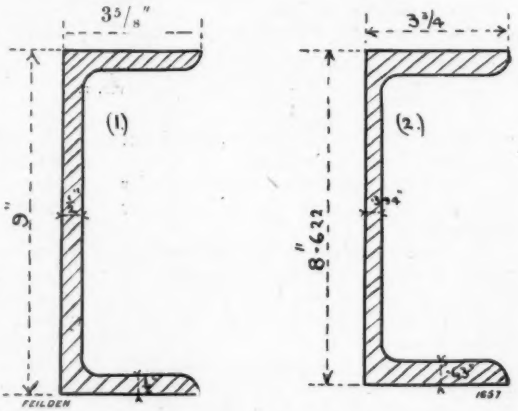


FIG. A.

If this system were adopted, the saving in weight would not compensate for the extra prime cost.

It would be possible to point out many ways in which the structural arrangements of a cruiser enable it to be built with much lighter scantlings, but that of the association of longitudinal with wider transverse framing is sufficient for our present purpose.

This, a great saving in itself, is accompanied by an even greater saving in shell-plating, for while a 6,000-ton cargo boat would have shell-plating of an average thickness of about $\frac{1}{2}\frac{1}{0}$ in., a

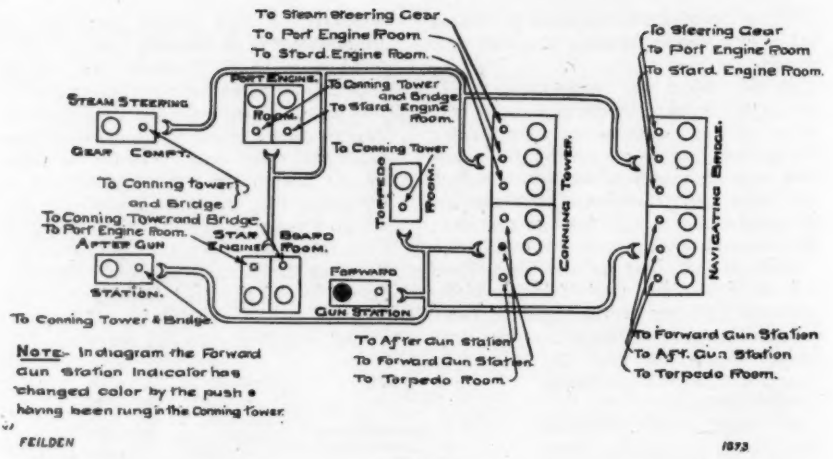

To Steam Steering Gear
To Port Engine Room
To Stard. Engine Room.
Port Engine Room.
To Conning Tower and Bridge
To Stard. Engine Room.
Steam Steering Gear Compt.
To Conning Tower
To Conning Tower and Bridge
To Conning Tower and Bridge
To Port Engine Room.
After Gun Station.
Star Engine Room.
Board Room.
Torpedo Room.
Conning Tower.
Forward Gun Station
To Conning Tower & Bridge
To After Gun Station
To Forward Gun Station
To Torpedo Room.
To Steering Gear
To Port Engine Room
To Stard. Engine Room.
Navigating Bridge.
To Forward Gun Station
To Aft. Gun Station
To Torpedo Room.
NOTE- In diagram the Forward Gun Station Indicator has changed color by the push having been rung in the Conning Tower.
FEILDEN
1873

FIG. B.

cruiser of equal displacement would not have much more than $\frac{9}{10}$ in.

Whether the merchant vessel has heavier plating than occasion demands is another question.

To such lengths are cruiser builders going, to secure lightness of construction, that sheer strakes and bilge strakes are now sometimes made of special high tensile steel.

By so doing these strakes have little more weight than the adjacent plating, while possessing the requisite strength.

Again, in some foreign-built cruisers the protective deck has been formed of special projectile-resisting steel, worked on a thin watertight skin of ordinary steel.

It is well known that the usual English practice is to build all the protective deck plates into the structure of the vessel, and owing to this, and the shape of the deck being of such inherent strength, only a limited number of beams are worked underneath it.

In the foreign cruisers already mentioned, where the armour portion of the deck is worked on a thin water-tight skin, beams are fitted on every frame.

Their contention is that the deck needs the *local* strength afforded by these beams, in order to effectively resist a shell.

As the armour has comparatively few connections (in the shape of tap rivets), their view is a correct one.

When the whole of the deck is riveted together into a concrete mass any sudden shock to a part of the deck would be transmitted to a larger area, and the greater number of beams are not required.

Therefore the gain in weight by fitting special armour in such a way is compensated for in the smaller number of beams required.

For the reader who holds no remarks of much account unless backed up by figures, it may be interesting to compare the following results:—

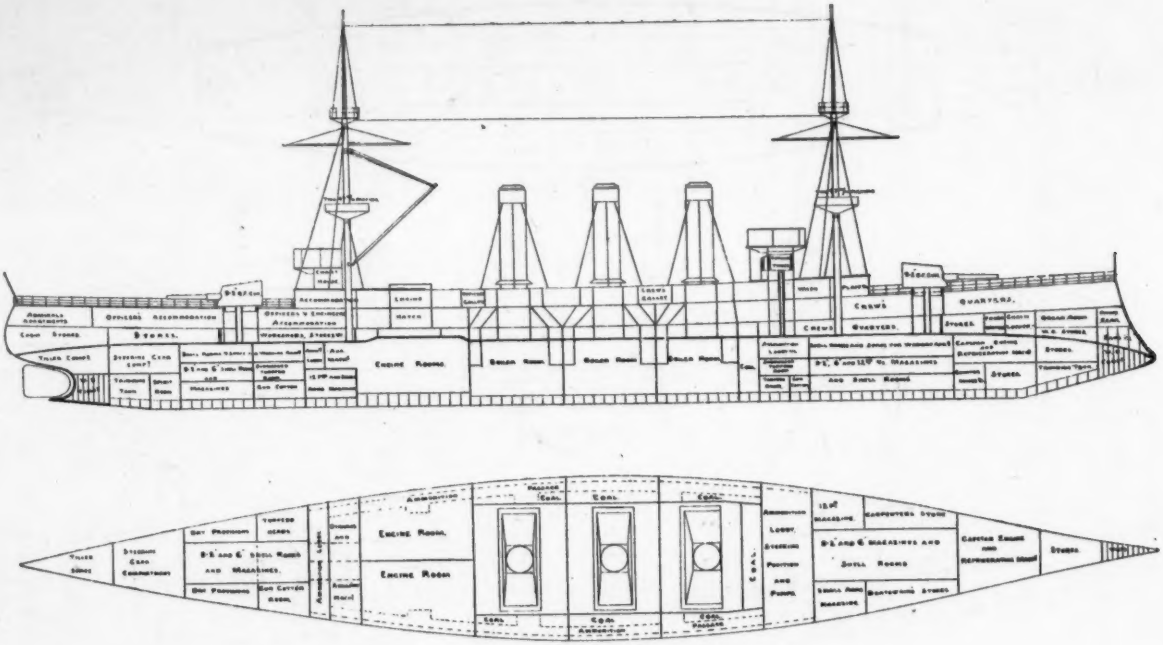
In the case of two cruisers of high speed, and about 4,000 tons displacement, the total weight of hull, excluding armour, is found to average 32.75 per cent. of the total displacement.

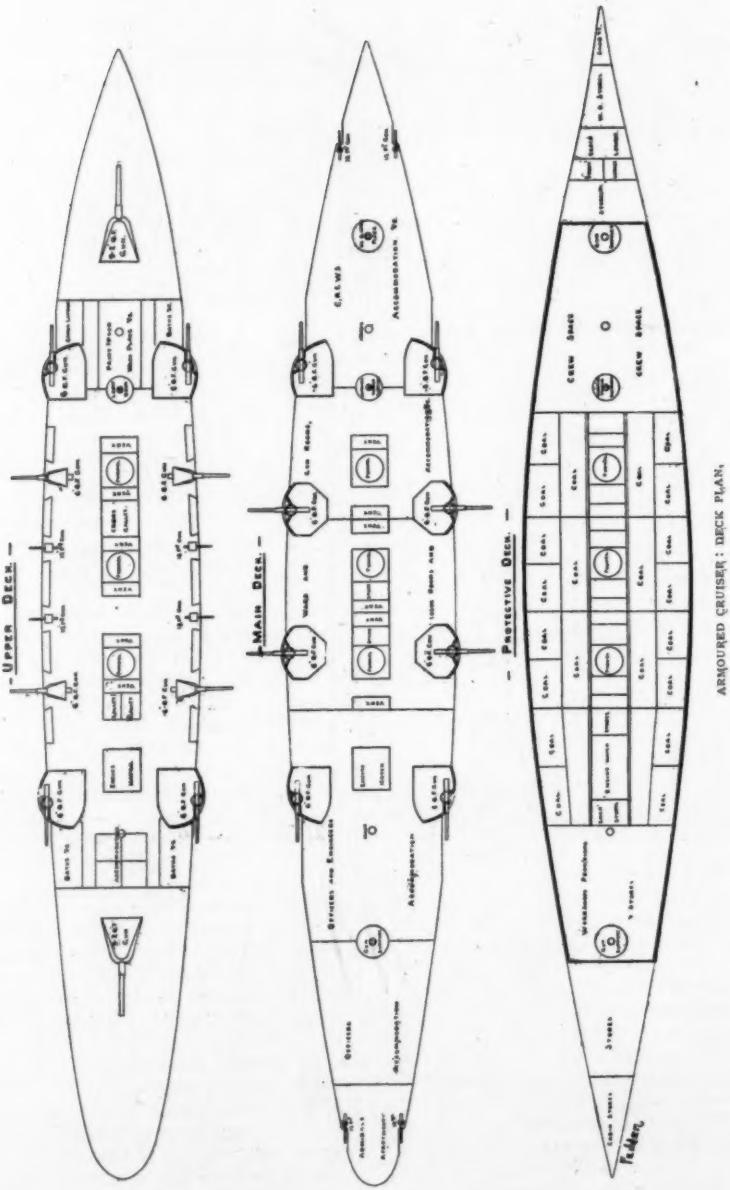
In two fast passenger vessels, taken at random, and of similar displacement, this weight is found to average 37.75 per cent.

These results speak for themselves!

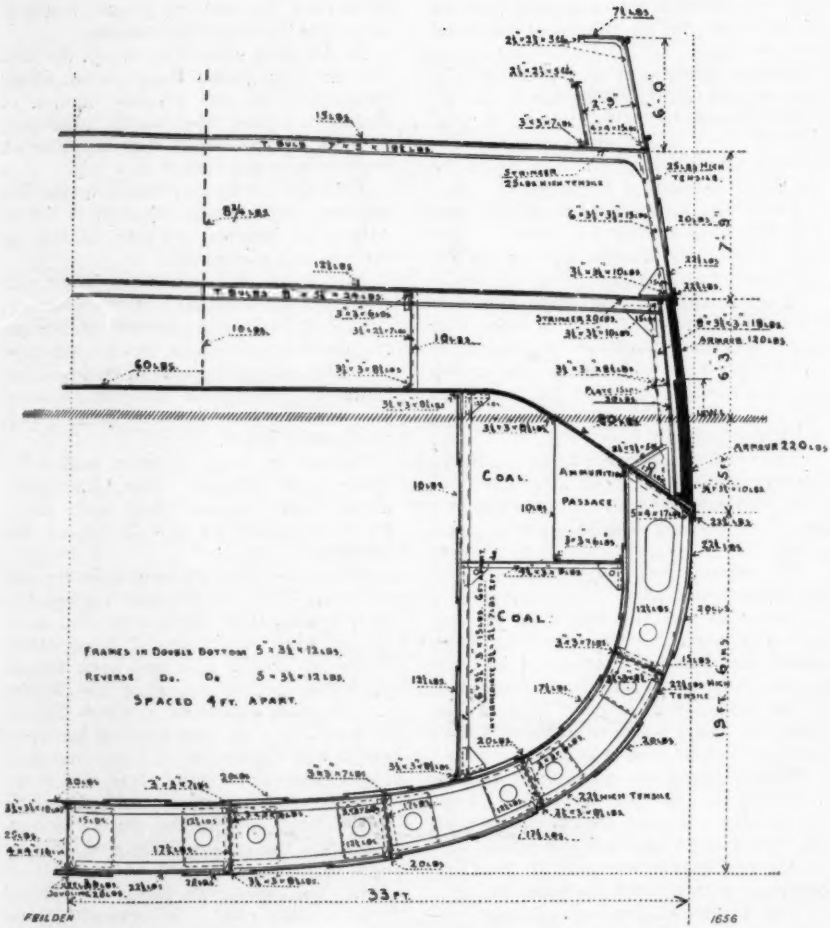
The writer hopes it may not be counted a tiresome digression to point out one direction, affecting shipbuilders generally, in which German builders can cut down the weight of their vessels.

It is the sections of bars used in their


Engine Room.
Engine Room
Coal.
Coal
Coal
Coal



ARMOURED CRUISER: DECK PLAN.



ARMOURED CRUISER: SCANTLING SECTION.

construction. It needs but a glance to see that a bulb-angle or tee-bulb are of greater constructional value than their predecessor the angle-bar; and as a natural consequence we find builders adopting bulb-angle frames, instead of the usual frame and reverse frame.

But when we examine the standard sections of zed and channel bars manufactured by British steel-makers, we find that much material used in the webs of these bars would be of much greater structural value if concentrated in the flanges.

By doing so the "moment of resistance" of the sections would be materially improved.

This fact the German steel-makers have already recognised and acted upon.

The result is that German-standard

zeds and channels have a greater moment of resistance for an equivalent sectional area or weight.

This is clearly seen in Fig. *A* and the approximate figures accompanying it.

The channel bar 8·622″ × 3·75″ × ·394″ and ·63″ thick is a German-standard bar, and the bar 9″ × 3⅛″ × ½″ is rolled by the Steel Company of Scotland.

From this comparison it will be seen that the German bar has about 12 per cent. greater resistance with practically the same sectional area.

It is an axiom among shipowners that "it is the last ton or two of cargo that pays," and the remark can be adapted so as to apply to cruisers, for a ton or two saved in the hull means so much more to use in extra horse-power or something equally important.

Therefore the above effects of theory upon practice merit more attention from our shipbuilders than those eminently practical persons usually bestow upon them.

The energy and money expended in fitting costly machines for joggling plating, in order to save the weight of packing pieces between the frame and the shell, would surely not be misdirected in overcoming the conservatism and independence of our steel-makers, in order to attain the saving of weight which would accrue from the use of more perfect sections.

Before leaving the question of weights, it may be said that the fast cruisers built at Elswick compare rather closely with the two foreign-built cruisers whose hull weight has already been said to be 32·75 per cent. of their total displacement.

The British Government do not consider it policy to run the weight of hull quite so fine as this, nor do they reduce the other weights to such an extent.

This is the cause of many unfavourable comparisons by popular critics, who quite ignore the fact that British cruisers have to act at great distances from their native shores, and consequently cannot put into dock so readily as those of some other navies.

They also have to carry a larger quantity of stores, number of rounds of ammunition per gun, etc., for the same reason; thus in another way causing greater displacement with equivalent armament.

At the same time, if we accept the idea that the ship (other things being equal) which can fire the greatest number of rounds in a given time has the advantage, it must be confessed that the Elswick cruisers have the best of it.

This can be directly traced to the fact that the said firm take the greatest care to reduce all weights, whether of hull or fittings, to a minimum.

And this is done without a larger relative cost than a similar British cruiser.

Passing to the consideration of fittings, the development which has caused most comment in modern vessels, is the substitution of corticene or linoleum for wood as a covering medium to all decks except the weather decks.

Indeed, in some German and other foreign-built cruisers, even the upper decks have corticene laid upon them, as is customary in British torpedo destroyers.

Of course immunity from splinters, and the smaller risk of fire, had a great deal to do with this innovation, but it is questionable if it would have found favour so rapidly if it had been accompanied by greater, instead of less, weight.

The other directions in which the use of wood has been abandoned of late years are so well known that it is not necessary to do more than merely enumerate them.

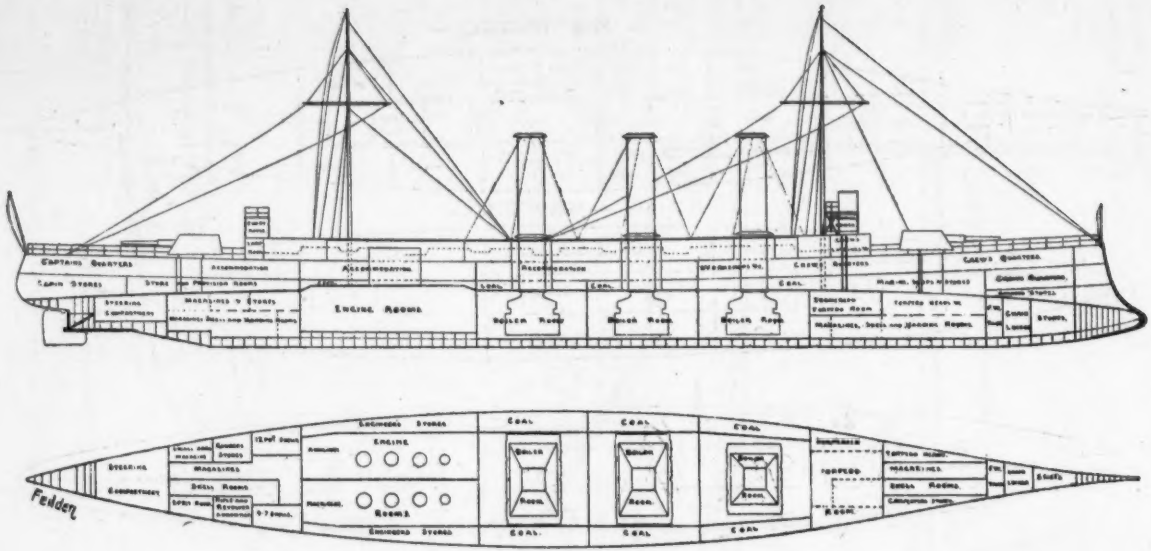
In the crew's quarters wood ceiling is no longer fitted, and in the officers' accommodation the ceiling is formed of very light steel sheets.

In some cases these sheets are covered with woollen cloth; in others they are thickly covered with cloth, holland is laid on that, and the whole cork painted.

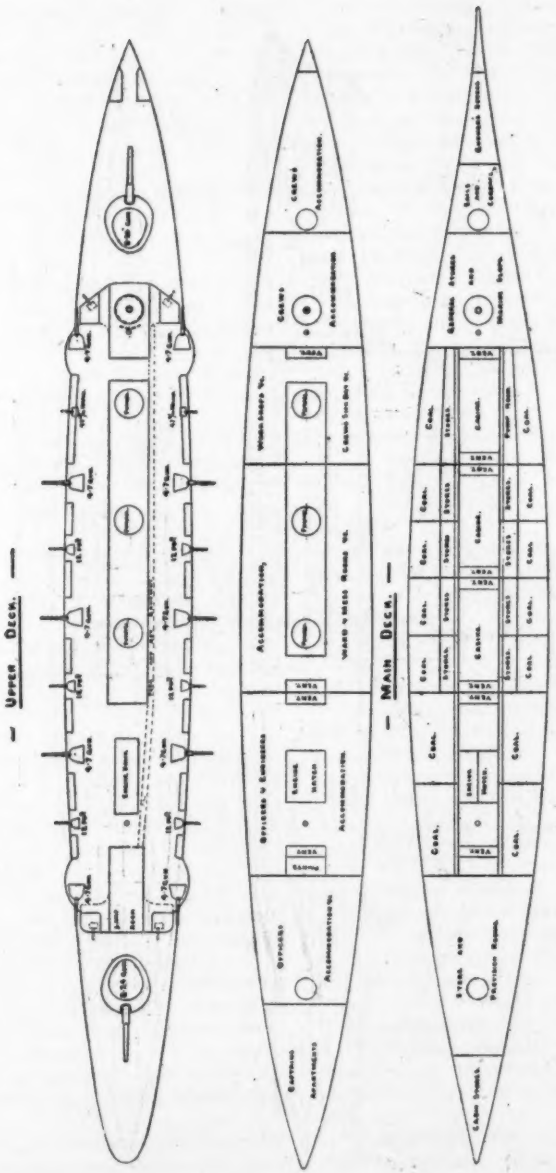
Wood is no longer fitted for handrails or ladders, other than those in which appearance is a consideration.

In the magazines and shell rooms there is a tendency, especially in American-built cruisers, to greatly reduce the quantity of wood used in linings, shelves, racks, etc.

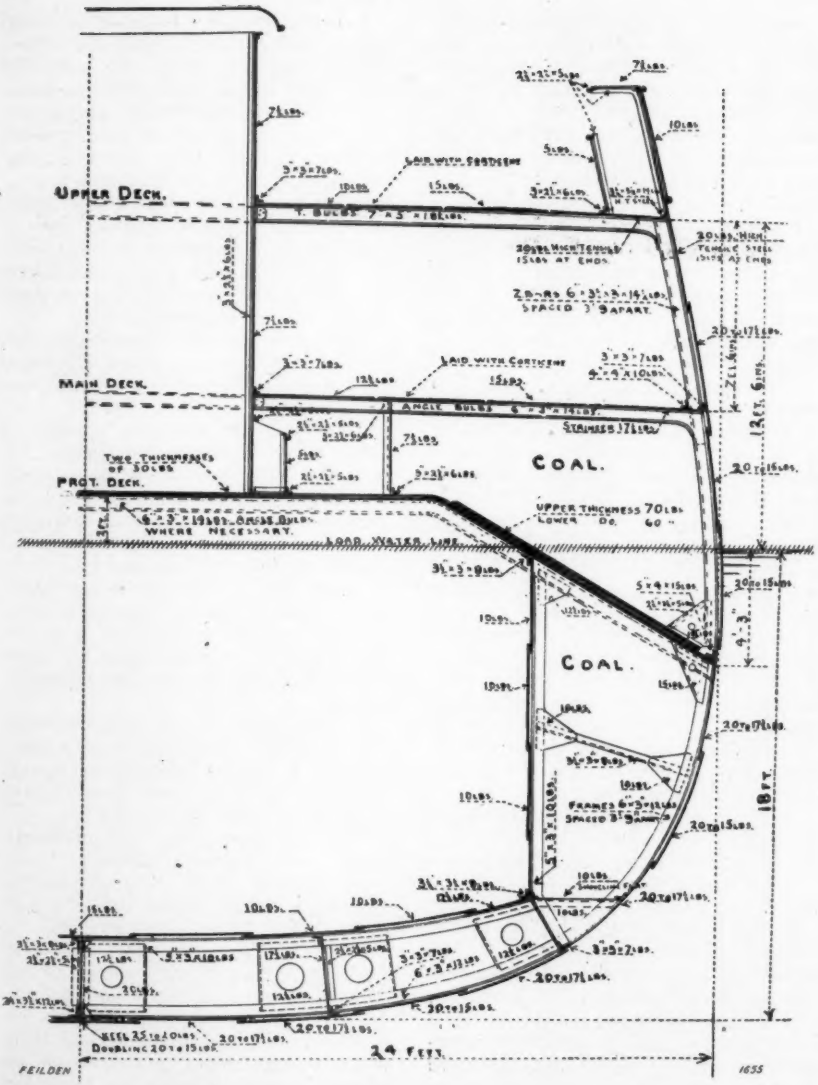
Chart-houses, etc., are now built of steel. Topmasts, signal-yards, and flagpoles are also made of steel.



FAST PROTECTED CRUISER: ELEVATION AND HOLD PLAN.



FAST PROTECTED CRUISER: DECK PLANS.



FAST PROTECTED CRUISER: SCANTLING SECTION.

Cabin fittings, such as beds, chairs, etc., are in some instances principally made of metal.

Steel boats are rapidly ousting wooden ones. In short, it may now be said that the danger of fire will arise more from the outfit of the living spaces, in the shape of bedding, linen, carpets, curtains, minor fittings, and the personal effects of the vessel's complement, than from the wood used in their construction.

While reducing the danger from fire and splinters, these innovations have had a happy effect upon the weights, as almost without exception the result has been a saving, and it is now difficult to see how any material advance can be made in this particular direction.

While speaking of the use of wood, it is interesting to note that the Swedish Government, with characteristic originality (for it may be remembered that they were the first Government to possess a torpedo-boat proper), have introduced a feature which is entirely novel so far as the writer knows.

They have fitted bilge keels *without* the usual wooden filling, caulking the plating, and fitting drain-cocks instead.

The saving in weight thus effected, even after making due provision for strengthening the sides of the keel against water pressure—which provision is not needed where wood filling is used—is very considerable. In the case of large bilge keels it would be, say, three tons; no mean gain on bilge keels!

So far, we have principally considered the vessel's structure; but while this structure may be excellent, it gives no protection to vital internal elements of the vessel.

In the larger cruisers, where weight is available, an armour belt can be worked at the water line, and the main armament can be placed in armoured casemates, which are served with ammunition through independent armoured hoists from an ammunition passage below the protective deck.

The protective deck itself gives efficient protection to engines, boilers, magazines, and steering gear.

The arrangement of such an armoured cruiser is clearly shewn in the sketches herewith.

In the smaller vessels — protected cruisers as they are termed—the protection is dependent upon the protective deck alone, as it is manifestly impossible to add the great weight of an armour belt.

Now, as the protective deck forms a boundary to all the most important compartments of the vessel, and as these compartments are almost entirely under water, while each is kept quite distinct from its neighbour by transverse and longitudinal water-tight bulkheads, a complete system of lighting and ventilation by artificial means becomes imperative.

Efficient means of communication from each compartment to others dependent upon it, and to the conning tower, is also necessary.

The ventilation is usually provided by fitting steam-driven fans, one forward and one aft of the machinery spaces, from which light steel air trunks are led to the various spaces, the air trunk in each space being fitted with a suitable number of louvres in each compartment.

Where these trunks pass through water-tight bulkheads patent automatic valves are fitted, so that, in the event of any one compartment becoming flooded, the water-tightness of the adjacent ones is not impaired.

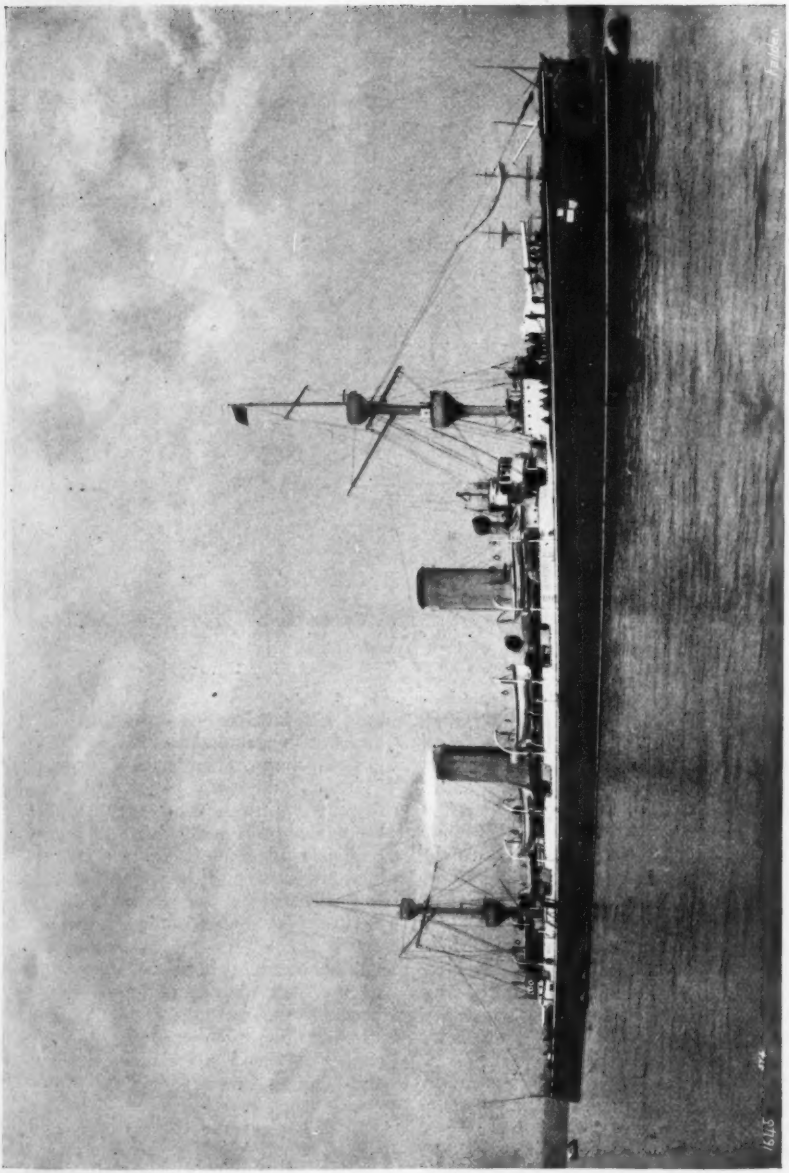
Besides this, valves are almost as necessary to prevent the free passage of flames in case of fire, for these trunks, through which air is being driven, would form a medium for spreading fire.

The use of electric fans, instead of steam fans, is now becoming common.

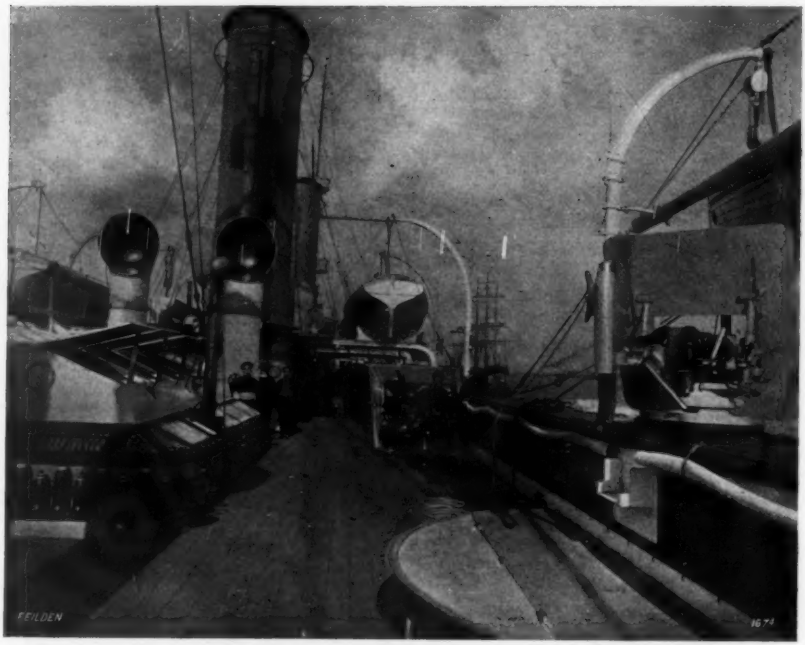
The exhaust air is either allowed exit through air-escape pipes, led to a sufficient height above the water-line to prevent any possibility of water flooding the space through them, or advantage is taken of convenient trunks or hatchways.

The ventilation of engine and boiler space belongs rather to the marine engineer's province, depending as it does upon the type of boiler and arrangements as to forced draught.

Above the protective deck, greater use



THE FASTEST CRUISER IN THE WORLD: HIS IMPERIAL CHINESE MAJESTY'S SHIP "HAI CHI."



HIS IMPERIAL CHINESE MAJESTY'S SHIP "HAI CHI": PORTION OF DECK VIEW.

can be made of natural ventilation, and this offers no special difficulties.

The lighting is done by fitting a dynamo or dynamos under the protective deck. This dynamo is really only intended for use in action, etc., as it is usually fitted in conjunction with a second one, placed in the upper works, which lights the vessel under normal conditions.

In a protected cruiser reliance has to be placed in the ability of the vessel to float with a number of compartments damaged and flooded, as the protection afforded by the deck does not prevent the possibility of many compartments being injured by shell fire.

At the same time, communication between many of these compartments is necessary, so recourse to water-tight doors has to be made.

Water-tight doors have always been considered a source of danger, as they may chance to be open just at the moment they should be closed.

Great improvements have been made in them, and many patent quick-closing doors have been used, but, as none of them have been perfect, there is a growing tendency to reduce their number. In fact, we now find few fitted below the protective deck, except those between engine and boiler rooms and in the magazines.

The communication between compartments, to all intents and purposes isolated, becomes an important problem, as means of bringing each separate unit of the vessel's working under the master hand in the conning tower, as well as protecting such means, have to be considered.

This has generally been done by adopting a system of voice pipes or even telephones, but each of these systems is open to grave objections.

A happy mean between them has been introduced recently and has given general satisfaction. I speak of the combination of speaking tubes and electric call bells.

In this system we are enabled to provide a main tube with numerous branches, as attention at any particular branch can be obtained by an electric call bell.

At the same time it can be seen from whence the call proceeds, for it is shown upon an indicator similar to that used in conjunction with cabin bells.

The arrangement will be more clearly understood by referring to the sketch diagram shown in Fig. B.

The large circles shown in the diagram denote indicators, and the smaller ones represent the electric push.

The figure only shows one or two tubes with their branches, as an example of the system.

In such a case all the more important tubes are protected throughout their whole length, as they are led from the conning-tower through an armour tube, together with the steering rods or telemotor pipes, and engine-room telegraphs.

Where only comparatively small weights can be worked into protection, this is the only feasible way of keeping these vital elements, or "nerve system" of the vessel, out of harm's way.

The importance of having them under protection is seen by referring to the following incident in the Chino-Japanese war :—

One of the cruisers had a group of speaking-tubes, led together along the upper works, struck by a stray shot during an engagement, consequently the communication between conning-tower and several important places was destroyed at once. With the tubes led through an armour tube and along under the protective deck this accident would not have happened.

The telemotor gear, casually referred to above, is a great advance upon the older steering gear and rods, with their complicated gearing.

In this gear the power necessary to operate the steering apparatus, whether situated in a compartment right aft or in the engine-room, is conveyed through small hydraulic pipes of about $\frac{5}{8}$ in. dia., which can be taken in any direction required.

In cruisers, where it is necessary, in order to preserve trim in action, etc., to fit very elaborate pumping and draining and flooding arrangements to the several compartments, this is usually done by fitting a large drain or collecting pipe through the whole length of the engine and boiler spaces, and it is connected to a centrifugal pump or pumps in the engine rooms.

This, which we may term the "Main Drainage System," as it deals with by far the largest compartments in the vessel, has suction branches and valve boxes so arranged that each of these spaces may be drained independently.

In some navies, where it is considered objectionable to have water having access from one compartment to another through this drain, even though the compartments can be isolated by means of valves, separate pumps are fitted in each of these rooms.

The draining of the double bottom is also done by the engine-room pumps through auxiliary suction pipes.

The pumping of the remaining spaces, or "Auxiliary Drainage System," is by means of Downton or similar pumps, with suctions to the various compartments, magazines, shell-rooms, store-rooms, etc.

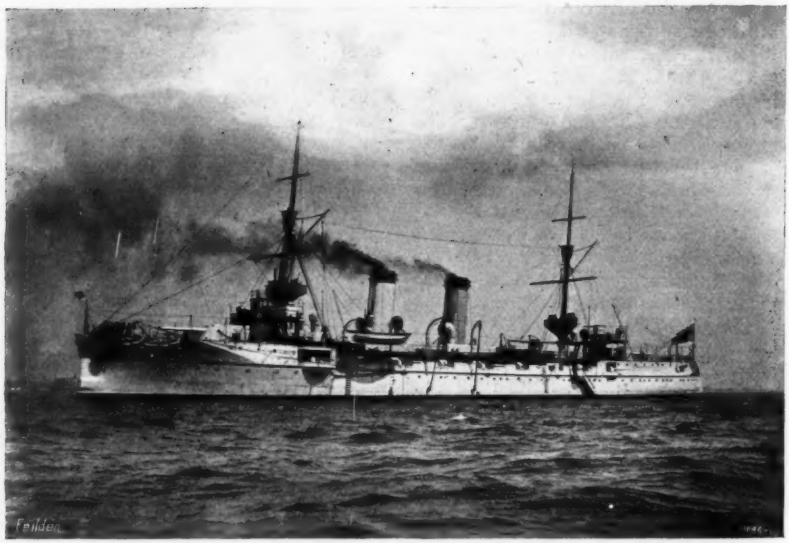
The flooding of the double bottom is attained by connecting sea inlet valves to the above mentioned auxiliary suction pipes, while magazines, shell-rooms, etc., are flooded by separate sea inlet valves fitted with branches.

Bunkers are drained indirectly by having sluice-valves to the boiler-room compartments.

The fresh and salt water services, and the fire services, though necessarily more elaborate than similar services in merchant steamers, do not present any points of special interest.

The trend of this article might seem to ignore the "fighting machine" idea altogether, while dealing with details.

But that is not so ; a perfect structure is only perfect so far as it enables the vessel to carry guns, and to transport them from point to point, giving them at



HIS IMPERIAL JAPANESE MAJESTY'S SHIP "TAKASAGO."

the same time as efficient protection as circumstances permit.

And while huge strides have been made in speed and protection, the armament has not lagged behind one whit.

While the ordnance has steadily improved, especially in the directions of greater muzzle velocities and energies on a smaller total weight of gun, the shipbuilder has striven to find place for a greater number of them, and so a double advantage has been gained.

This is clearly seen when we compare such ships as H.M.S. *Furious*, a second-class cruiser built in 1886, with a ship of the same class built in 1897, H.M.S. *Hyacinth*.

Although the first-named vessel has 100 tons greater displacement, and a knot less speed, her main armament consists of four 6-in. quick-firing and six 4·7-in. guns, against eleven 6-in. quick-firing guns in the *Hyacinth*.

This is one example out of hundreds to show the immense superiority of modern fast cruisers in the matter of armament.

And it must be remembered that the increased efficiency of individual pieces is even greater than the gain in offensive properties resulting from the tendency to mount more guns, for the merest novice knows that the modern 12-in. wire-wound gun is better in all ways than the older 16-in. 80 ton gun in vogue some years ago.

While the former (according to figures taken from "Brassey's Naval Annual") has a muzzle energy of over 33,000 ft. tons, the latter had only about 30,000.

And this is combined with a saving of 22 tons weight, for the 12-in. gun only weighs 46 tons, to say nothing of the quicker fire of the smaller piece.

These remarks apply with equal force to the smaller guns.

The outline sketches which accompany this article are intended to give a general idea of the disposition of guns and general arrangement of two distinct classes of cruisers.

The protected cruiser, a name usually applied to vessels having no protection

except that afforded by a protective deck, is designed to give the greatest possible speed and sea-going qualities, with a sufficient number of guns having shield protection, to render her a dangerous enemy.

The one sketched as a representative of the class has a length of 380 ft., with a breadth and draft of 48 ft. and 18 ft. respectively.

Her normal displacement is 4,775 tons, and she has a speed of 23 knots with about 16,000 h.p.

Steam is supplied by water-tube boilers.

It will be seen that the one and only torpedo-room is submerged.

There is a growing tendency to abandon the use of above water-tubes, especially in the larger cruisers, and the tendency is based upon sound reasoning.

Vessels are now fitted with such a number of guns, and they are efficient at such extreme ranges, that it is scarcely possible to imagine the use of torpedoes except to administer the *coup de grâce* to an already disabled opponent, or to prevent the ramming of such an opponent.

The primary armament, it will be noticed, consists of two 8·24-in. quick-firing guns, and ten 4·7-in. quick-firing guns, all fitted with shield protection only.

Fighting tops are not fitted, as modern cruisers are now frequently built without them.

Her secondary armament would consist of four 3-pounder and 37-mm. Maxim guns.

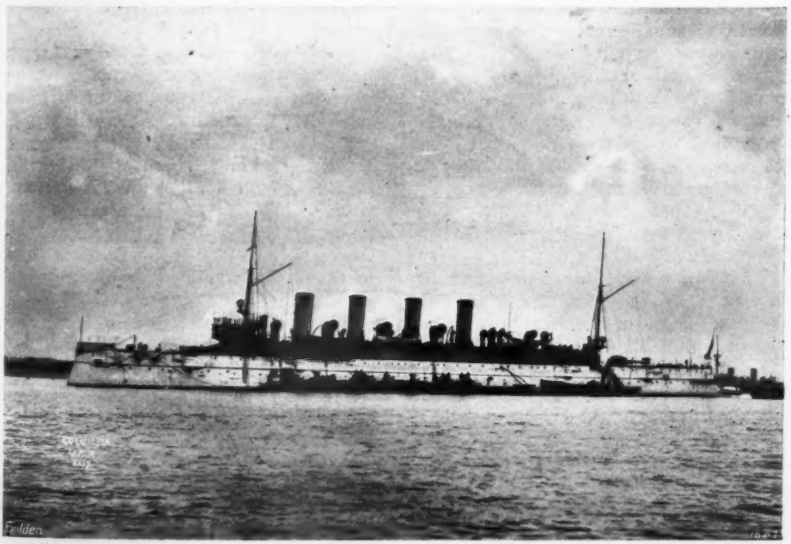
The sketches styled "armoured cruiser" are designed to typify the class of vessel which has become popular in such a short while.

The protection is very greatly superior to any that it is possible to give to a "protected cruiser," consisting in this instance of a $5\frac{1}{2}$ in. armour belt, surmounted by a second belt 3 ins. thick to the height of the main deck.

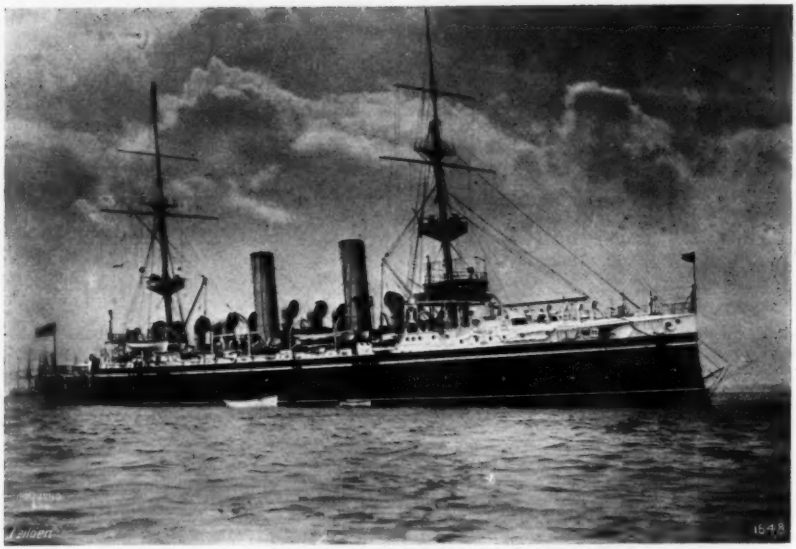
The belts are terminated forward and aft at an armoured bulkhead.

There is also a protective deck all forward and aft, and 12 of the 6-in. guns are in armoured casemates $5\frac{1}{2}$ ins. thick.

Of course, this protection, which,



UNITED STATES CRUISER "COLUMBIA."



HER MAJESTY'S SHIP "HYACINTH."

together with her heavy armament, makes the vessel a semi-battleship, can only be attained on a much greater displacement.

The vessel illustrated displaces 9,700 tons. The main armament consists of two 9·2-in. quick-firing guns with shield protection, twelve 6-in. quick-firing guns in armoured casemates, and four 6-in. quick-firing guns with shields only.

The secondary armament is composed of eight 12 pounders and ten 47-mm. Maxims.

The direct ahead or astern fire is very heavy—one 9·2 and four 6-in. guns in each case.

With a length of 420 ft., breadth of 64 ft., and draft of water of 24 ft. 6 ins., this vessel would attain a speed of 20½ knots with 16,000 h.p.

This combination of high speed, heavy armament, and efficient protection, is what has caused such a demand for this class of vessel.

Able to dispose of any "protected" vessel, it may even try conclusions with a battleship, secure in the knowledge that it can outsail her enemy whenever it may be convenient to do so. The chance of her machinery being damaged is also very remote.

Owing to the courtesy of Colonel Watts, the writer is enabled to give a photo and some of the leading particulars of one of the most remarkable protected cruisers afloat, viz. H.I.C.M.S. *Hai Chi.*

This vessel and her sister ship the *Hai Tien* were built by the celebrated firm of which Colonel Watts is the director—Sir W. G. Armstrong, Whitworth & Co., Ltd.

She is 396 ft. long, 46 ft. 6 ins. beam, 30 ft. 4¾ ins. moulded depth, and 16 ft. 9 ins. draft.

With twin-screw four-cylinder engines of 17,000 h.p. collectively she attained the wonderful speed of 24 knots.

This high speed is attained by using forced draught to eight Scotch boilers working at 155 lbs. steam pressure.

Although so speedy, and of the comparatively small displacement of 4,500 tons, she has a protective deck 3 ins. thick on slopes and 1½ in. thick on flats, increased to 5 ins. on slopes in way of engines.

Her primary armament consists of two 8-in. quick-firing guns and ten 4·7-in. quick-firing guns, backed up with twelve 3-pr. Hotchkiss, four 37-mm. Maxims, and six rifle calibre Maxim guns.

Her normal bunker capacity is 300 tons, but stowage can be found for 1,000 tons if necessary, giving the vessel a range of about 5,000 miles at 15 knots.

In conclusion, let it be said that no attempt has been made to treat the subject in either an exhaustive or an orthodox manner, being rather a pointing out of the directions in which the improvements rendering such a vessel as the *Hai Chi* a *possibility* have been tending, than a disquisition into debatable points. The photographs of H.M.S. *Hyacinth*, U.S.S. *Columbia*, and H.I.J.M.S. *Takasago* are reproduced as examples of widely different types of fast cruisers.

The wish that the subject may prove a tithe as interesting to the reader as it is to himself are the concluding words of the writer.

Chas. E. Canning.

Pneumatic Tools and Appliances.

By EWART C. AMOS, M.I.Mech.E.

(Continued from page 68.)

❀ ❀ ❀

Reference was promised in the last article to the cost of working the system, but before dealing with that point, some particulars of a few special pneumatic machines, not hitherto described, may be interesting.

Fig. 103 shews a pneumatic tube-swaging machine for preparing locomotive tubes for copper ferrules. This machine will swage tubes from $1\frac{3}{4}$ in. to $2\frac{1}{2}$ ins. outside diameter, and is suitable for a working air pressure of 80 lbs. per sq. in., using a $\frac{1}{2}$-in. diameter supply pipe. It consists of a strong cast-iron frame, the left-hand portion of which forms a powerful vice, in which the tube to be reduced is held and centred. This vice is operated by a star wheel as shown. The other end of the tube rests against a yoke which can be moved in and out on the tie rods. Mounted on the framing to the right of the vice is a revolving turret, which is fitted with one bull nose to expand tubes that are too small, and five dies numbered 0, 1, 2, 3, and 4. No. 0 is the exact size of tube for which the machine is ordered, the others advancing by 32nds of an in. to take tubes that have been expanded beyond the normal size. The turret is fitted with a spring and taper pin on the top, and when the latter is in place one or other of the various dies comes into exact lines with the tube, the arrangement being the same in principle as an ordinary turret lathe. Underneath the framing is an air cylinder mounted on suitable trunnions and having its piston connected by a bell crank with the turret head. When compressed air is admitted on the top of this piston by means of the operating lever seen in the illustration below the pilot wheel, the turret holding the die is forced forward on to the tube with a pressure of about 6 or 7 tons. The end of the tube is thereby reduced, and is left perfectly round, and with any desired taper. A further movement of the operating lever releases the air from the top of the piston, and in turn admits compressed air to the under side, forcing the piston up, and withdrawing the turret and its die from the end of the tube. The exhaust air escapes through the die, cleaning from it any scale or dirt. The machine is then ready to receive another tube. The use of this machine dispenses with the heating of the ends of tubes, also with swage-blocks made in halves, besides which the work is done more rapidly and with less expense. A special and very useful application of a pneumatic drill is shown in Fig. 104. This illustrates a "Little Giant" type of drill, fitted with an expansion chuck as shown by Fig. 105. This is a very good instance of the advantages possessed by a portable power drill for doing work rapidly in confined spaces, a fact which has largely ensured the immense success of these machines. It is daily becoming evident that much work which previously had to be brought to the fixed machine can now be machined in place, and with the result that not only is better work done, but much time is saved in fitting. Such an arrangement as shewn in Figs. 104 and 105 lends itself to a number of similar purposes which will readily suggest themselves, especially in connection with ship and locomotive work.

Fig. 106 shows a portable casting cleaner in operation, which will do the work of four men, with less effort, and with a better result. This machine weighs only 8 lbs., and when not used for cleaning castings can be utilised for drilling, or any other purpose for which a pneumatic motor of this type is suited.

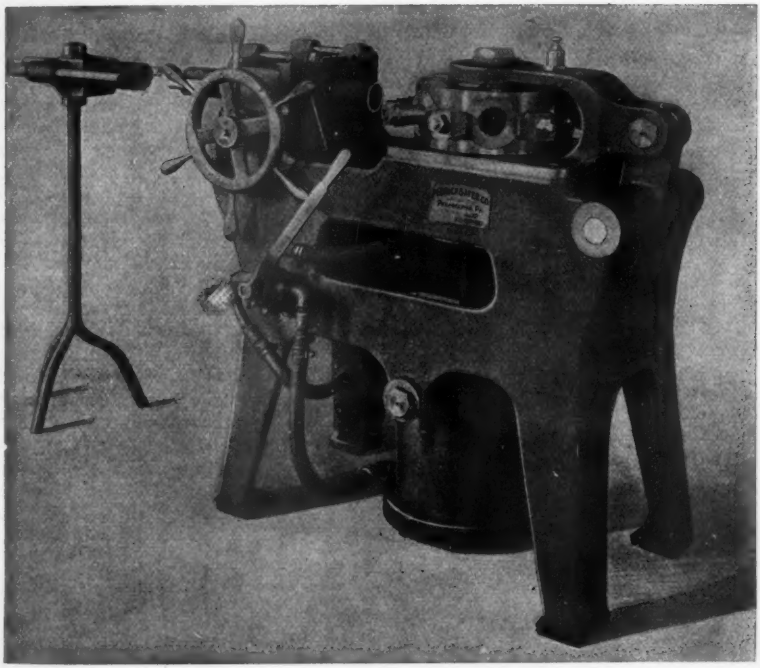


FIG. 103.—PNEUMATIC TUBE-SWAGING MACHINE.

Fig. 107 illustrates a "Caskey" type of hand riveter for light work, having a capacity up to $\frac{3}{8}$-in. diameter rivets. The air cylinder is direct acting, air being admitted and exhausted by twisting the milled spindle seen on the right of the cylinder.

It has not infrequently been stated that the modern type of percussion hammer is the old percussion rock drill over again. Probably there is some degree of truth in this, but refinement in construction, and improved arrangements in the valves for the control of the air have certainly resulted in a very different machine. The percussion rock drill driven by compressed air has done and is still doing excellent work in connection with mining, and especially in hard ores, but for drilling soft iron ore, coal, clay, salt, etc., and in fact, in anything where a hand auger can be operated, a pneumatic drill similar to those already described, but modified to suit the requirements of long hole boring, has been found very suitable.

Fig. 108 illustrates a "Little Giant" Mining Drill mounted on a column, and capable of drilling $2\frac{1}{2}$ ins. diameter holes at the rate of 6 feet per minute through coal or similar ore, fire clay, etc. The form of mounting shown lends itself to rapid setting up, and the drill complete with column only weighs 1 cwt. The drill can be used alone, and then weighs about 60 lbs. The drill is fitted with an automatic feed, which is adjustable from 0 up to 7 turns of the drill per minute. This feed can be arranged whilst the machine is in motion. The boring bar is fixed right through the machine, and can be made in any length to suit the various requirements. The drill is adjustable

FIG. 104.—NO. 4 "LITTLE GIANT" DRILL GRINDING SEAT.

round the column in any position. The standard length of the column is 6 feet, but can be increased. All the gearing and running mechanism is entirely enclosed and well lubricated, so that there is no fear of the drill getting out of order due to the grit or dirt which is always present in mining work. The value of compressed air for mining purposes and when working in confined spaces is already known, and this adaptation of a modern type of pneumatic drill is likely to achieve considerable success.

"Time is money" is an old adage, and it is also very true to say of pneumatic tools that they save time and make money. Fig. 109 somewhat vividly illustrates the comparison of time between chipping by hand and chipping by a pneumatic hammer. In making this comparison due consideration must be taken of the cost of the power required for driving the hammer, and that point brings us to a consideration of the cost of the system. It may be stated at once that up to the present very little useful or reliable data has yet been obtained as to the working cost. In a paper recently read by the writer before the Institution of Mechanical Engineers on the subject of Portable Pneumatic Tools, this important question was briefly dealt with as follows :—

"When making comparison of the cost of work as between pneumatic tools and hand labour (and it must be borne in mind that they compete largely with hand labour), it is necessary to take into consideration three points. (1) That with the same sized shop and the same standing expenses in the form of rent, rates and taxes, and wages bill, a very great deal more work can be turned out in the same time. (2) That although against this there must be set off the cost of producing the compressed air, yet even supposing this equalled cost of manual labour (which it does not), there would still be a considerable saving for the reason given in item (1). (3) That, with hand-labour, especially in riveting, caulking, and place-drilling, work can only proceed at a very slow rate, however many men may be

FIG. 105.—EXPANSION CHUCK FOR STEAM PIPE RINGS AS FITTED TO "LITTLE GIANT DRILLS."

employed, and however closely together they work. This frequently becomes a serious matter in ship and bridge-building, railway works, etc., and even were the cost double that of hand labour, other advantages as regards speed, etc., should outweigh it; but, as a matter of fact, when properly carried out the saving is very considerable, and it is, in the author's opinion, only a question of time, and that not far distant, when every engineering shop will find it absolutely necessary, if it wishes to keep in the van of progress, to adopt the pneumatic, or some similar system of portable tools."

It is also necessary to add to these general remarks two additional and important points, viz. (1) that the work when done is generally far superior to the best hand labour produced; and (2) that, with the exception perhaps of chipping and caulking, the work is far less laborious. This latter is an important point, since it is now well recognised that the better the conditions under which the operators work, the greater the amount of work done; whether the point of view is humanitarian or selfish the result remains the same, and it is not difficult to realise that a man would prefer to manipulate a pneumatic-drill in preference to a ratchet brace. Even when it is a question of chipping, the first objection, which results from a want of experience in handling the machine, is considerably reduced when practice is acquired, and in the case of piece work more money can be earned both by the employer and employee by the use of air-driven tools.

Coming now to some figures, and assuming that it requires 1 h.p. to compress 5 cub. ft. of free air to a pressure of, say 80 lbs. per sq. in., which is a very fair average in present day practice, it becomes evident that compressed air as a form of energy is a somewhat expensive one. Going still further we find that a pneumatic drill requiring about 45 ft. of

FIG. 106.—PNEUMATIC CASTING CLEANER IN OPERATION.

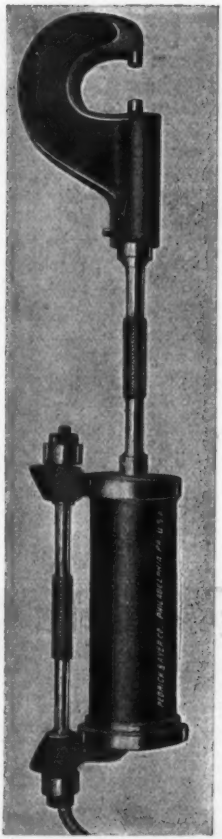


FIG. 107.—"CASKEY" HAND RIVETER.

free air per minute only develops about 3½ h.p. as a motor, so that an air-driven motor requiring, say 9 h.p. to supply the air, only gives out about one-third of that power. In the face of these figures it might be supposed that pneumatic tools would be very expensive in working in relation to the work done, and probably they would be found so if put into competition with fixed machines, driven by belt or electric motor; but they are essentially portable machines, and compete chiefly with hand labour, and in such capacity practical results have proved that they are effecting a very great saving, besides securing results hitherto unobtainable.

Whilst the potential energy of 1 lb. of coal is very considerable, we get nothing like it in the engine cylinder, and there is a further loss before we get it off the crank shaft, and a still much greater loss before we obtain it on the fixed machine for actually cutting the metal. In fact, it may be stated that in an average shop the actual useful power of the engine devoted to the cutting of the metal in the various machines is less than half the i.h.p. of the engine. Notwithstanding this loss, the immense benefit to be derived from the use of fixed machine tools is now so well recognised that the last few years has seen a steady and rapid decline in hand work and a great increase in machining. It is not so very long ago, however, that the milling machine, the capstan lathe, and other automatic tools were looked upon rather as special and costly, and for a considerable time after their advent users put up with the old-fashioned lathe and shaper rather than incur the additional capital outlay. Things are now rapidly changing, and notwithstanding the apparent extravagance of the pneumatic system, practice is showing that not only are pneumatic tools immense labour savers, but the work done by them is vastly superior to hand labour.

The question of the most useful pressure at which the air should be worked is a most important one, yet it has received but scant attention. So far there is no recognised rule—in this country, at any rate. The writer knows of works where 50 lbs. per sq. in. is the maximum pressure obtainable, whilst in others as much as 125 lbs. per sq. in. is used. Now it is very evident that different results will be obtained from these pressures, and it is not an uncommon thing to ascribe failure to the machine when it really belongs in most cases to the want of sufficient pressure. It has been suggested that greater economy would be effected if, instead of allowing the exhaust to escape into the air, it was conveyed back into a receiver from which the compressor drew its supply of air. For instance, in order to secure a mean working

pressure of, say, 100 lbs., the initial pressure should be 200 lbs. and the exhaust 100 lbs. There is no doubt that considerable loss due to variations in temperature and other physical causes would be avoided, but against that are disadvantages due to greater possibilities of leakage in both the joints of the piping and of the machines themselves, and, further, the objection of a return-pipe, which has also to be kept air-tight, and where the tool is being used at a considerable distance from the source of air supply this largely increases the cost of the plant. Speaking generally, and having reference to the class of machine at present on the market, the writer suggests the following pressures as likely to give the most satisfactory results, viz. :—

Hammers for caulking and light chipping -	per sq. in. 75 to 80 lbs.
Heavy hammers for chipping and riveting	100 to 125 lbs.
Yoke riveters - - -	100 to 125 lbs.
Light drills - - - -	75 to 80 lbs.
Heavy drills - - -	80 to 100 lbs.
Air hoists - - - -	70 to 80 lbs.

The writer favours the higher pressures, but as already stated it is possible to work the machines at a lower pressure. For riveting, however, good work cannot be done below 90 lbs., and 100 to 125 is certainly preferable. The question of leakage is also one requiring some reference. It will be found to effect a saving if a careful inspection—say once a week—is made of the whole system. A considerable quantity of air will get through a very small opening in a very little time, and since it does not smell as in the case of coal gas, nor is it visible as in the case of steam, the inspection has to be more thorough. An easy way is to close the whole system under pressure, and if any serious fall is noticeable to examine the joints. An air joint will not rust up so readily as a steam or water joint, and hence greater care has to be taken when making them. Notwithstanding such care, however, there is always sure to be a certain amount of leakage, if not from the joint then from the tools themselves, and allowance has to be made for this when putting down the compressing plant. On the other hand it must be remembered that in tools of this kind, and where there are a number at work, it is generally the case that they are not all being used at once; still, it is very advisable that there should be a surplus rather than a deficiency of air supply, since in a properly designed compressor little work is done when the receiver is full, the automatic controlling device providing for this. Much annoyance and disappointment has been frequently caused by shortage of air supply, and users should be prepared to put down a larger compressor than they appear to require, since it will pay them in the long run, and apart from the fact that the larger compressors are the more economical. It will also be generally found that once a system of compressed air supply is laid down it can be utilised for many purposes.

Of the various types of pneumatic tools and appliances which have been described

FIG. 108.—NO. 0 "LITTLE GIANT" MINING DRILL

in these articles, probably none have a greater importance than the portable pneumatic drill. In making this statement the great value of the portable riveter, especially in connection with ship work, is not forgotten. It is true that a pneumatic hammer will chip, caulk, rivet, or bead, yet the drill, with its numberless applications, is likely to have a still wider range of usefulness. Hand drilling, reaming and tapping have always been laborious processes, and have necessitated the use of material not always best adapted for its purpose. The use of a "Stow" flexible shaft has, to some extent, overcome the difficulty, but this method of transmitting energy is likely to be largely, if not entirely, superseded by the pneumatic motor.

In a comparative test made with a pneumatic drill against a flexible shaft for the purpose of tapping holes in locomotive fire-boxes, it was found that it required 36 secs. to tap a hole by the pneumatic motor, as against 1 min. 48 secs. with the flexible shaft. Again, a locomotive boiler-tube 1¾ in. diameter can be expanded in 30 secs., as against 8 to 10 mins. with hand rolling. This machine was then using 25 ft. of free air per minute at 80 lbs. pressure. The same machine will tap holes at four times the speed of hand tapping. This means that not only is the cost of labour very considerably reduced, but that the work is in the shop for a much shorter time. Take, for example, a boiler flue 30 ft. long by 2 ft. 9 in. diameter. This would take about eight to ten days by hand caulking, but from an actual test made with a pneumatic hammer it was found possible to caulk it in 10 hrs.

From what has already been said it becomes evident that many things have to be taken into consideration when making comparative tests, but, speaking generally, results so far have proved that in riveting and caulking the use of pneumatic tools has effected a saving of at least 50 per cent. over hand labour.

In drilling and boring, the results are equally satisfactory. It is now found that steel castings can be advantageously used for purposes where previously forged work was necessary, owing to the difficulty of hand drilling the harder metal. Again, with a pneumatic drill, rymering is such a simple and inexpensive matter that it is now becoming the practice to rymer in riveted work in place of using a drift-pin, the results being far more satisfactory. As an example, it is found that two men with a pneumatic reamer can ream something like 2,000 holes per day. Again, both in bridge and ship work there is often not sufficient space to swing a hand hammer in driving a rivet, as, for instance, the rivets fastening the beam knees to the frames, or in the connection of the floors to the centre keelsons, and other places where it is important to make a good joint.

The pneumatic hand riveter is not affected by this want of space, since it will work wherever it can be got on to the rivet. In a recent test made with a chipping hammer, it was found possible to remove in one chip a piece of Bessemer steel ½ in. wide × ½ in. thick × 18 ins. long, and weighing nearly 12 lbs., in 2 mins. 56 secs. This is a great saving over hand labour, and in emergency work the advantage is almost inestimable.

Many other examples might be given, but enough have been cited to indicate the immense possibilities and advantages which lie in the use of portable pneumatic tools.

In conclusion, it must be pointed out that since the writer commenced these articles many improvements have already been effected both in the design and construction of these machines, and notwithstanding the fact that the first article appeared only in December last.

It is doubtful whether any class of modern labour-saving device has made such rapid strides or secured such a hold on the market as portable pneumatic tools, and even when expressing a very moderate view of their effect upon the engineering industry as a whole, it is not too much to say that they are revolutionising, and will in the near future still more so, our present system of manufacture. In the writer's opinion we have only just begun to realise the great benefits resulting

from their application, whilst developments in their construction will tend to give still better results. In America their sale has been prodigious, and there is every indication that this country intends to fully take advantage of their value in engineering construction.

Ewart S. Amos

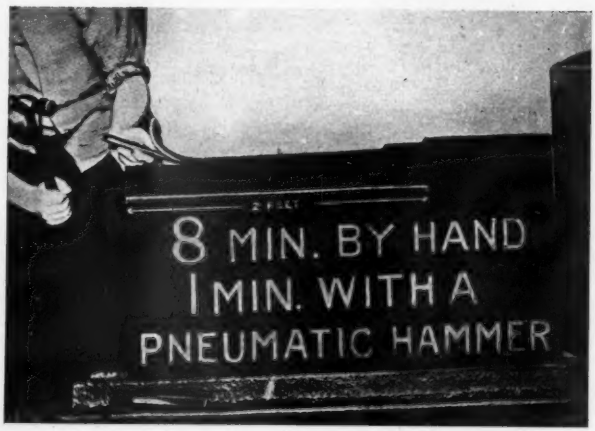
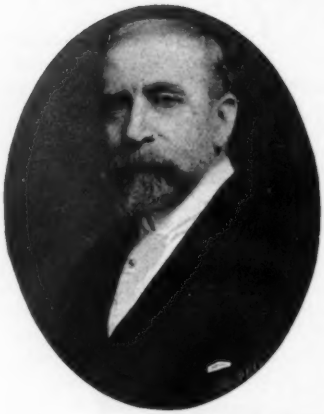


FIG. 109.—SHOWING RESULTS AS BETWEEN HAND AND PNEUMATIC CHIPPING.

The Central London Railway.

By W. M. TWELVETREES, M.I.Mech.E



Mr. Walter Noble Twelvetrees was born at Boston, Lincolnshire, and educated at Totteridge Park Schools; King's College, London; and Owens College, Manchester. He was articled to a firm of mechanical engineers, and has had considerable experience with regard to the engineering requirements of various industries in the North of England, in India, and the Colonies. He was engaged for many years in the design of machinery and in the application of engineering and sanitary appliances in public institutions, steamships, etc.; and is at present practising as a consulting engineer in London. He is a member of the Institution of Mechanical Engineers, of the Sanitary Institute, and is a Vice-President of the Civil and Mechanical Engineers' Society. He is a member of the editorial staff of Feilden's Magazine.

"See how regardless of my power are these waves." The monarch to whom these words are ascribed was evidently a man of greater discernment than his successor, who, some 600 years later, thought it possible to check the flowing tide of metropolitan extension by means of Royal Proclamations. As we all know, King James the First was not more successful in his endeavour to limit the boundaries of London than in his attempt to discourage the use of tobacco. The flood of houses and other buildings, which seemed so appalling to our ancestors, still continues in every direction. The irresistible sea of bricks and mortar relentlessly absorbs hill after hill and valley after valley, until we cease to wonder where and when its power will be finally expended. Although the growth of London cannot be stopped, it may be regulated in various ways for the public good. Unfortunately, however, each generation thinks and acts for itself alone, so that what is done one day at great cost has to be undone another day at much greater cost. This condition is to some extent, but not entirely, unavoidable, for it is often the case that intelligent and well-considered administrative measures continue to produce beneficial effects long after their authors have passed away. As long ago as the year 1661, we read that St. James's Street, Pall Mall, and Piccadilly were built, and several other streets were ordered to be widened. Some improvements were effected in rebuilding the City after the Great Fire of 1665, when the streets were increased in width, and houses were constructed of more substantial materials, but the admirable scheme devised by Wren for the reconstruction of London on an intelligible basis was defeated by the jealousies of the citizens. Wren proposed to build main thoroughfares north, south, east, and west; to insulate all churches in conspicuous positions; to form large piazzas at certain

points; to rebuild the halls of the chief City companies around a square in the vicinity of the Guildhall; and to make an embankment on the riverside from Blackfriars to the Tower. At that time these works could have been carried out at a merely nominal cost, for the convenience of that and every succeeding generation. But the grand opportunity was allowed to pass, and in the present day we have had to pay millions of pounds in consequence of the folly of our forefathers. Similarly undesirable expenditure has been, and is still to be, incurred in respect of newer parts of the metropolis. Even when all the improvements now contemplated shall have been completed, London will still remain a more or less tangled maze of inconvenient thoroughfares. So far as railways are concerned, the chief thought at one time was to give access to the metropolis from other parts of the country, and, as far as possible, each terminal station was placed where it was least wanted. Consequently, each of the great railway companies has had to spend immense sums of money, at later dates, in establishing additional or duplicate stations upon more accessible sites. About the year 1860 it was in contemplation to erect a grand central railway station in the city, so that passengers might be transferred from one line to another without contributing unnecessary traffic to the public streets. If this scheme had been carried out upon a sufficiently ample scale, and with due provision for the future extension of traffic, its value should have been immense. But the City Fathers thought otherwise, and large numbers of people are still obliged to travel on the surface, instead of proceeding underground from one station to another, or of changing trains at the grand central station which ought to have been established. After a time came suburban railways, wandering in circuitous and devious ways around the outskirts of the town; and then, about 1868, the Metropolitan and District Railways, which constituted the first attempts to introduce highways of the kind needed by the temporary and permanent occupants of London. The completion of the Inner Circle, as late as the year 1882, tended, in some measure, to link together the scattered terminal stations of the various railway companies, and to facilitate traffic generally, but it furnished no means of direct transit from north to south, nor from east to west, in the most crowded parts of the metropolis. The difficulties attending the great question of rapid locomotion are considerably increased by the fact that many persons whose daily work is performed in the northern or eastern districts of town prefer the southern or western suburbs for residential purposes, whilst many whose places of business are in the south or west choose to live in the north or east.

Adding the unnecessary, but perfectly justifiable, traffic so caused to the unavoidable traffic towards central districts from outlying stations, such as London Bridge, Waterloo, Paddington, Euston, and others, it is not wonderful that cabs and omnibuses have multiplied and replenished the streets and subdued them. Between the hours of morning influx and evening efflux these crawling creatures are largely used and appreciated, for the simple reason that the nineteenth century has not, until quite lately, found any better means of locomotion for the most densely crowded streets of its greatest city. Various schemes have been suggested from time to time for relieving the congested state of London street traffic. As long ago as the year 1846, Sir Frederick Bramwell proposed, as he tells us, "the construction of subterranean railways in London, to be carried down into London clay so as to secure a good stratum in which to work, and also a position below and clear of all the sewers and other matters situated a short distance beneath the surface." The railway was originally designed by him to extend from the Bank to Charing Cross, but subsequently it was proposed to carry it to Hyde Park Corner. At the City end, its station was to be in certain property at the back of the Old Jewry, and Sir Frederick, in conjunction with Mr. Homersham, a civil engineer, and Mr. Boulnois, an architect, worked out the system, including the method of taking passengers up and down by means of

hydraulic lifts. The attempt was also made to promote a similar line for the purpose of carrying passengers between Waterloo Station and Hungerford Market. At the time of which we write, electric traction was unknown, and Sir Frederick Bramwell proposed the adoption of the Valance system of pneumatic propulsion. The tunnels were to be rectangular in form and lined entirely with cast-iron plates. Neither of these prophetic schemes met with any encouragement, but they are interesting evidence that the needs of London were correctly appreciated more than half a century back. In the year 1864 several Bills were submitted by the most thoughtful of professional men for the consideration of Parliament, involving the possible construction of about 175 miles of metropolitan railways. Only a small proportion of these projected lines were approved, and once more London had to wait; fortunately, as events have proved. Eight years later the proposal was made to construct an underground line from Whitechapel to the Marble Arch. This railway was not to proceed beneath Oxford Street, though its course would have been adjacent to and parallel with that busy thoroughfare. For some reason this scheme was absolutely rejected, although its usefulness must have been abundantly evident to every practical mind. A few years afterwards, when the practicability of electric traction was completely demonstrated, and when financial objections to low-level tunnels

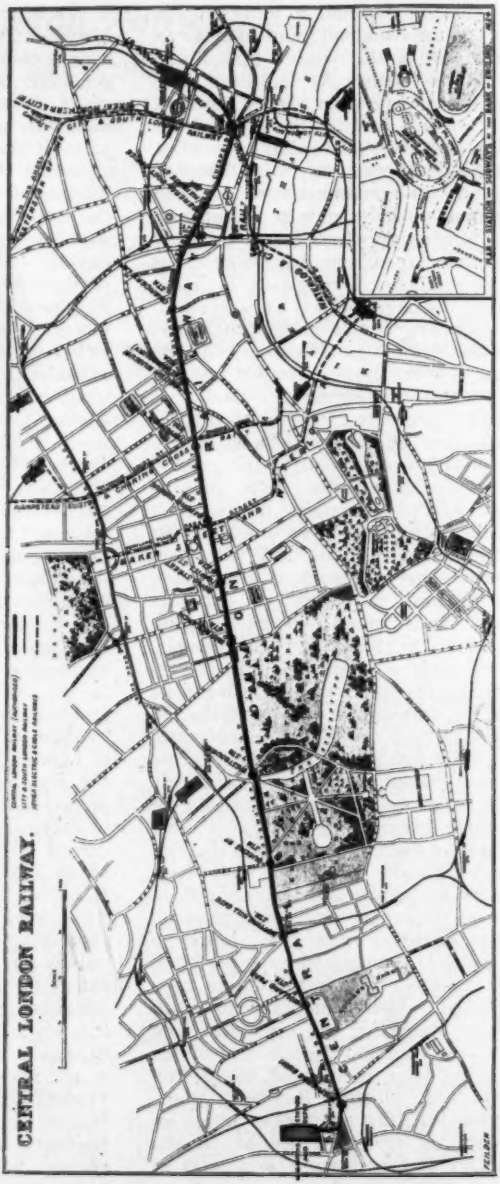


FIG. 1.—GENERAL PLAN OF THE CENTRAL LONDON RAILWAY FROM SHEPHERD'S BUSH TO THE BANK, WITH ENLARGED PLAN OF THE BANK SUBWAYS

were removed by the boring shield, invented by the late Mr. J. H. Greathead, the City and South London Railway was commenced, and brought to a successful issue.

Then people began generally to realise the enormous benefits to be derived from an intelligent and systematic exploitation of the bed of clay uniformly buried beneath the great city, and hitherto untouched by the handiworks of man. In that silent and unexplored region there is room and to spare for innumerable highways, into which men may dive far below the raging sea of traffic overhead, and through which they may be swiftly borne to their destinations. It is unfortunately the fact that concerted measures for the improvement of the metropolis are seldom if ever taken, and so far as low-level railways are concerned, each has been promoted on its own merits as fulfilling some individual requirement, instead of being designed as a portion of one comprehensive scheme which should ultimately provide systematised inter-communication for the whole metropolis. At one period of his career, Mr. Greathead hoped to secure the adoption of such a system, but numerous difficulties convinced him of the impossibility of attaining this ideal. Chief amongst these was the sacred privilege of every land owner to claim, with some exceptions which we need not stop to consider, absolute proprietorship over all material lying between the surface of his land and the centre of the earth. This right is naturally valuable in mining districts, but is not likely to be so in London in relation to strata lying 60 or 70 ft. below the surface, except perhaps for the purpose of levying toll upon the labour of other people. The exercise of this undoubted right naturally tends to restrict underground railway enterprise to sites beneath the public thoroughfares. Such routes are by no means undesirable, but others may frequently be necessary. In a better managed city than London, and in a less conservative country than England, the administrative powers of the Legislature would be invoked for the purpose of encouraging and organising schemes for the development of the new method of locomotion, instead of merely holding expensiye inquiries, chiefly devoted to the hearing of objections brought forward for their own advantage by the commercial opponents of each new venture.

To private enterprise we owe the City and South London Railway, the City and Waterloo Railway, and now the Central London Railway, as well as the projection of other works of a similar nature already in progress or in contemplation. Our present concern is with the Central London line, recently opened by the Prince of Wales, and now fully occupied by the general public. It is unnecessary to refer in detail to the contest evoked by the Bill brought forward by the promoters of the line. Everyone knows that so eminently desirable an undertaking would be sure to encounter the most determined opposition, which, however, it has happily survived.

The Central Railway Company was formed in 1895, three years after the sanction of Parliament had been obtained. Sir Henry Oakley, formerly general manager of the Great Northern Railway, is the chairman of the company, and Mr. R. O. Graham, who was connected with the North Eastern Railway, is the secretary. The engineers first appointed were Sir John Fowler, Sir Benjamin Baker, and Mr. J. H. Greathead, the latter of whom, unfortunately, died in 1896, and so was unable to witness the completion of the line. At the present time the joint engineers are Sir Benjamin Baker and Mr. Basil Mott, M.Inst.C.E. Instead of making a number of separate contracts with various firms, the company accepted the offer of the Electric Traction Company to construct all the necessary works, to furnish the whole of the plant and rolling stock, and to hand over the system in complete working order during the month of June, 1900. There can be no doubt that the adoption of this course has very much simplified the labours of the railway company, and it has at the same time precluded the possibility of misunderstandings, which frequently arise when responsibility is divided amongst several contractors. The sum payable to the Electric Traction Company is £3,114,000, and the following is a list of the chief sub-

contractors, with a general indication of the work executed by each :—

Mr. John Price : Construction of tunnels from Shepherd's Bush to the Marble Arch.

Messrs. Walter Scott & Co. : Construction of tunnels from the Marble Arch to the Post Office.

Mr. George Talbot : Construction of the Bank Station and the tunnels from the Post Office to the Bank.

The British Thomson-Houston Co. : General sub-contractors for electrical power plant, including sub-contractors marked *.

*The General Electric Co., Schenectady, U.S.A. : Electric locomotives.

*Messrs. Babcock & Willcox : Provision of water-tube boilers at main generating station.

*Messrs. E. Green & Sons : Fuel economisers for steam boilers.

*The Edward P. Allis Co., Schenectady, U.S.A. : Stationary engines for power generation.

*Messrs. Belliss and Morcom, Ld. : Electric lighting engines and plant.

The Sprague Electric Co., New York : Station lifts.

Mr. J. R. Furman, M.Am.Soc.C.E. : Installation of lifts.

The Ashbury Carriage and Waggon Co. : Rolling stock.

The Brush Engineering Co. : Rolling stock.

It is probable that no line hitherto constructed has had the benefit of so much professional skill as the Central London Railway. In addition to the distinguished engineers directly representing the company, the interests of the general contractors have been watched over by Mr. Ferdinand Hudleston, M.Inst.C.E., and several of the sub-contractors have necessarily been obliged to entrust the supervision of important works to competent engineers, amongst whom may be mentioned :—Mr. Thomas Thomson, M.Inst.C.E., Mr. A. Woodroffe Manton, M.Inst.C.E., M.I.M.E., Mr. J. R. Furman, M.Am.Soc.C.E., etc.

The resident engineers on the work under Sir Benjamin Baker and Mr. Basil Mott were Mr. H. Copperthwaite, A.M.Inst.C.E., and Mr. W. J. E. Binnie, A.M.Inst.C.E.

From the foregoing brief statement some idea may be formed of the multitudinous details and immense responsibilities attaching to the execution of the contracts, and our readers will probably join with us in congratulating all who have conduced to the successful termination of the preliminary works connected with this valuable undertaking.

In Fig. 1 on page 316 will be found a map showing the route followed by the new railway, including the proposed extension to Liverpool Street. From this plan it will be seen at a glance that the Central line traverses the northern part of that busy central district which has hitherto been totally devoid of any modern facilities for locomotion. From morn to eve the great highway between Shepherd's Bush and the Bank is the happy hunting-ground of countless omnibusses, moving east and west, in two solemn processions, whose ranks are broken here and there by a few other vehicles, which are forced in by persevering drivers in the great central artery of the metropolis. Henceforth, the passenger who is anxious to reach his destination will, probably, leave the omnibus to him who desires to admire the architectural and other beauties of London.

The positions of the various stations are sufficiently indicated on the plan, but the following particulars as to the distances from one to another may be interesting :

		Yds.
Shepherd's Bush Depôt	Shepherd's Bush Station	1,036
Shepherd's Bush	Holland Park	1,012
Holland Park	Notting Hill Gate	683
Notting Hill Gate	Queen's Road	768
Queen's Road	Westbourne Park	986
Westbourne Park	Marble Arch	1,288
Marble Arch	Bond Street	642
Bond Street	Oxford Circus	699
Oxford Circus	Tottenham Court Road	666
Tottenham Court Road	British Museum	682
British Museum	Chancery Lane	746
Chancery Lane	Post Office	1,163

		Yds.
Post Office	Bank	828
Bank Station	Bank Sidings	200

Thus the total length from the end of the sidings at Shepherd's Bush to the end of the sidings at the Bank is 11,399 yds., or 6·47 miles. It will be observed on reference to the plan, that the terminus is shown at Liverpool Street. This is in accordance with the original intention of the promoters, but although sanctioned the extension to Liverpool Street will not be made until an agreement has been concluded with the Great Eastern Railway Company. We understand that it was proposed to carry the Central line beneath Liverpool Street station, and there to form a terminus from which direct communication would be made with the platforms of the Great Eastern line. It is difficult to imagine why the latter company should raise any objection to a scheme possessing such obvious advantages. The distance from Liverpool Street to the Bank is not great, but considering the crowded state of the thoroughfares in that part of the city, it is highly undesirable that passengers should be compelled to travel from one point to the other by cab or omnibus. We trust that some day the reasonableness of this view may occur to those who are now blocking so useful a connection. At present the Bank station is in communication with the City and South London line and with the City and Waterloo line, and the same subways provide means of access between the stations of the two latter railways. It will therefore be seen that passengers arriving at the Bank from north, south and west will be able to change trains and proceed expeditiously to other parts of the metropolis without contributing more traffic to the already over-burdened streets in front of the Mansion House.

A detailed consideration of the Central London Railway would furnish ample material for several fair-sized volumes, and it is impossible, within the limits of an article such as the present, to attempt more than a general description of the whole work, with some special references to features representing recent progress in civil, mechanical, and electrical engineering.

(To be continued.)

W. H. Worthington

MACHINERY, APPLIANCES AND PROCESSES.

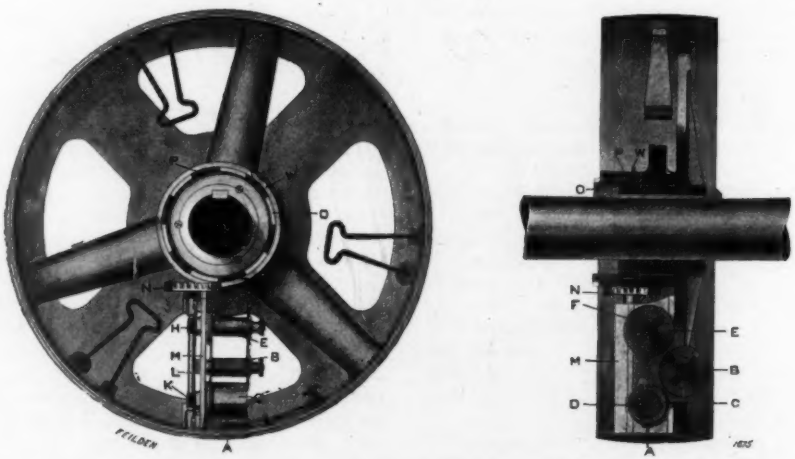
"Every part and side of our life, from the cradle to the grave, has been touched and tended by the inventor and manufacturer. His works are as numberless as the sands of the sea, but the onward rush of Science and the Arts opens up new fields of discovery and enterprise as each day dawns. Let us choose here and there among thousands, and in choosing take the best as far as in us lies."

A NEW TORSION DYNAMOMETER, OR RECORDING TORQUE METER.

THE matter of transmission dynamometers has for a long time occupied the attention of engineers, because it is only by the help of such instruments that complete information on points of great interest can be obtained. As the employment of power-driven machinery is ever extending, and that at a rapid rate—the problem of the production and distribution of the requisite power becomes more and more important. No problem can be considered as being truly solved until our knowledge concerning its various factors is complete, and in the case of the mechanical driving of some machine or plant full information of the prime requirement is rarely forthcoming in definite and satisfactory form.

Referring to the problem of electric driving, before deciding upon the proper size of electric motor to use for any given purpose, it is necessary to know what power is required; and although the average power may sometimes be ascertained, it is exceedingly difficult to determine the torque required at any particular instant, especially if the variations thereof are rapid, and it is this instantaneous torque which largely influences the decision of a choice of a motor.

Various methods have been employed for determining the average power required for driving a machine. Indicator diagrams have been taken from a steam engine, both whilst the machine in question is being driven and also while it is out of action, but this method is rarely attempted, and the results, except



FIGS. 1 AND 2.—NEW TORSION DYNAMOMETER.

FIG. 3.—NEW TORSION DYNAMOMETER.

under the most favourable conditions, are not of any definite value. Perhaps the handiest method is to drive the machine temporarily by means of an electro-motor and measure the watts supplied thereto, but omitting any reference to the fixing of the motor and to the gearing used for the purpose, it has been frequently found that the power absorbed is taken in such an irregular manner that it is practically impossible to obtain readings from the meters employed owing to the violent oscillation of the needles, and the only information gained is that which may, perhaps, be termed a "guessed average." Similar reasons have probably prevented transmission dynamometers from being more generally used.

In the case of any machine or apparatus driven through the medium of a revolving shaft or pulley, a complete knowledge of its power requirements would be obtained did we know the torque applied thereto at all instants and also the speed of revolution. The total energy absorbed in any interval of time could then be ascertained by a process of integration independent of the speed; or, by introducing the time factor, the power required could be determined by simple and reliable calculations. A complete knowledge of the torque required would also enable an engineer to decide whether the use

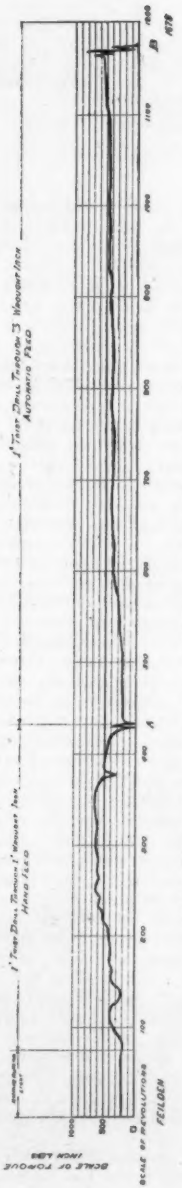


FIG. 4.—NEW TORSION DYNAMOMETER.—DIAGRAM TAKEN FROM A 42-IN. DRILLING MACHINE.

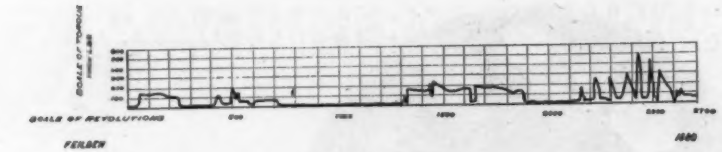


FIG. 5.—NEW TORSION DYNAMOMETER.—DIAGRAM TAKEN FROM COUNTERSHAFT OF A 6-IN. LATHE.

of a fly-wheel could be of any advantage, and, if so, what would be the economical dimensions to employ. It is obvious that if the torque be constant, or nearly so, a fly-wheel is only a waster of energy ; but, on the other hand, if the torque varies rapidly, a fly-wheel becomes either a useful appliance or an absolute necessity.

Fly-wheels can only be designed accurately from a complete knowledge of torque and the permissible speed variations. The above considerations point to the necessity for some means of obtaining the desired knowledge, and our object is to describe an instrument which can produce a permanent record or indicator diagram of torque. The diagram may also be used as a means of determining the total amount of energy transmitted in the interval of time during which the diagram was taken.

The principles embodied in the well-known dynamometer coupling, so intimately connected with the names of Professors Ayrton and Perry, have been followed by the inventor in his experiments on this subject, and it may be remarked, in passing, that the sole reason for his entering into these investigations was to find some means which would enable him to determine accurately the best size and description of electro-motor to employ for driving various machines, and at the same time to ascertain whether a fly-wheel could be added with advantage. He soon found, in the cases most commonly met with, that it was almost impossible to obtain useful information concerning the power demanded, sometimes because it was impracticable to make any preliminary tests, and sometimes on account of the rapidity and magnitude of the variations of the quantities to be measured. As a comparison with the circumstances of the latter case, one might as reasonably attach common Bourdon gauges to the cylinders of a steam engine, with the object of obtaining readings of the effective steam pressures, as to attempt to measure torque with the help of instruments in common use at present.

The dynamometer or torque recorder described below has, perhaps, some points of interest, and a reference to the accompanying diagrams, Figs. 1 and 2, will make its construction clear.

The meter consists of two main parts, one called the disc, which is rigidly attached to the revolving shaft, and the other the pulley, which rides freely on the central boss of the disc. The pulley is connected to the disc by means of standardised springs of a special form ; these driving springs are readily removable, and afford the facility of easily varying the useful range of the meter. The disc, pulley and springs can, without further description, be distinguished in the diagrams Figs. 1 and 2 and photograph Fig. 3.

The amount of distortion of the springs is a measure of the torque applied to the shaft, and is recorded as a diagram on a strip of paper. As a general rule, no device for magnifying the distortion of the springs is used, but a scribing point A is attached to any convenient part of the pulley, and provided with such a spring as will cause it to bear on the strip of paper. Thus, as the driving springs open and close, the scriber travels to and fro, producing a transverse line on the strip of paper which appears plainly in Fig. 3. Whilst the shaft and disc revolve, the paper is caused to travel forward proportionally to the amount of rotation by the devices described below. The recording, or in other words, the travel of the paper, may also be started and stopped as frequently as desired without stopping the whole apparatus or the working of the driven machine, and this end is achieved by a special arrangement of the gearing employed for driving the recording mechanism.

The long strip of paper is carried on three drums, mounted on a frame or bracket M rigidly attached to the disc. The first drum B is called the store drum, and serves to hold the supply of paper. The strip of paper then passes over the recording drum C, which, being positively driven by the worm and wheel D (Fig. 2), K (Fig. 1) is caused to rotate on its axis ; thence the paper is carried on to the third drum E. The paper receives the diagram whilst passing between the scriber and the recording drum.

The third drum E is also driven by means of a worm H, but a slipping or frictional

drive is interposed between the worm wheel *F* and the drum, so that this drum can only revolve just fast enough to take up the slack of the strip of paper as fed forward by the recording drum. By this means the paper travels forward over the drum *C*, at a speed proportional to the rate of revolution of the shaft, and, at the same time, compensation is allowed for variation in the diameter of the roll of paper on the third drum. The tension of the paper is regulated by simple friction devices connected with drums *B* and *E*.

The two worms *H* and *K* are formed on a spindle *L*, supported by the bracket *M*, which carries the three drums, and this spindle is provided at the end towards the shaft with a crown-wheel *N*, gearing with a worm *W*, formed on a ring *P*, mounted concentrically with the main shaft, to which the instrument is attached. This ring is provided with projecting pieces *O*, against which some externally fixed pawl or detent may be brought. So long as the worm-ring *P* revolves with the shaft the strip of paper remains stationary on the drums, but when the rotation of the ring is prevented by means of some detent engaging with the projections *O*, the worms *H* and *K* drive their respective wheels, thereby causing the recording drum to rotate, carrying the paper forward with it under the scribing point. It has been found necessary to attach a second scribing point either to the disc or to the bracket *M*, in some position near the recording scriber, in such a way that a longitudinal straight is marked on the paper. This line serves as a base from which all measurements of torque may be made, and errors due to the want of straightness in the strip of paper are obviated.

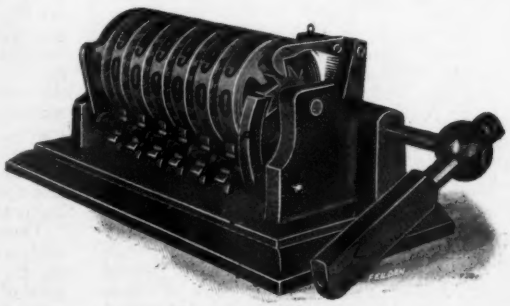
By using a variety of rings, carrying worms of various numbers of threads, the paper is made to travel at any desired rate.

From this mechanism a diagram is obtained whose ordinates are proportional to torque, and whose abscissæ represent a definite and known number of revolutions of the shaft, and the two diagrams, Figs. 4 and 5, are given as examples, showing the information which can be obtained by the help of this instrument.

Fig. 4 was taken from a 42-in. drilling machine; and Fig. 5 is a portion of a diagram taken from the counter-shaft of a 6-in. lathe doing plain turning approximately 2 ins. diameter. In the first instance the dynamometer served as the fast pulley, and consequently all motion ceased when the belt was thrown on to the loose pulley; this appears at the points marked *A* and *B* (Fig. 4), but in the second case (Fig. 5) the record was taken continuously over a long time, and the diagram shows plainly the times during which the tool was actually in cut.

BUCHANAN'S PATENT ENGINE COUNTER.

THE fact that engine counters are so frequently subject to breakdowns render the appearance in the market of a new device, which is more durable and reliable, very acceptable. We allude to Buchanan's patent engine counter, illustrated below, which by doing away with the pawl and escapement wheel, which wheel has been the cause of much mischief in engine counters, and by introducing a new motion on the first wheel, which turns up the figures full with the up-stroke, instead of the half-figures with the down-stroke and the other half with the up-stroke, as is the case in Harding's counter, overcomes the chief defect of the older types. The above-stated improvement is accomplished by fixing a steel ratchet to the first roller which is held in position by the pawl *P*, as the lever *L* is fixed to the shaft when moved up and down. The crank *C*, being fixed to the shaft *S*, moves backward and forward, carrying with it the drawer *D* which pulls the ratchet over one tooth at a time, and thus secures the turning up of the full figure at every stroke instead of the half-figure.



NEW PATENT ENGINE COUNTER.

Some Notable Exhibits at the Paris Exhibition.

(Continued from page 204.)

❀ ❀ ❀

FOUR-WHEELS-COUPLED COMPOUND PASSENGER LOCOMOTIVE, "LA FRANCE." (F. W. WEBB'S SYSTEM.)

THIS engine, now amongst the exhibits at the Paris Exhibition, is one of a type designed by Mr. F. W. Webb, chief mechanical engineer to the London and North-Western Railway. The first engine of this class, the "Black Prince," was built at the Crewe Works in July, 1897, and for some time after it was put into the running on alternate days. It worked the "Up" Dining Saloon Express, which left Crewe at 5.2 p.m. and ran through to Willesden, a distance of 152½ mls., without a stop, and returned to Crewe the same night with the Scotch Sleeping Saloon Express, leaving Euston at 11.50, running through to Crewe (158 mls.) without a stop. The total mileage run by this engine ("Black Prince") up to the 30th April, 1900, was 173,498. On the 8th June, 1895, another engine of this class, the "Iron Duke," ran a special train conveying the members of the Institution of Civil Engineers from Euston to Crewe and back on the occasion of their visit to Crewe Works. The weight of the train, exclusive of the engine and tender, was 339 tons, and the maximum speed obtained on the journey was 71 mls. per hour, the average speed being 50 mls. per hour. The length of the trip was 159 mls., and the amount of coal burnt was 3 tons 2 cwt., equal to 13·7 lbs. per mile.

The steepest gradient was 1 in 70 up.

Unlike other Compounds previously built by Mr. Webb, this engine has four cylinders, two high and two low-pressure, the former being 15 ins. diameter and the latter 20½ ins. diameter, the stroke in each case being 24 ins. All the cylinders are in line, the high-pressure being outside and the low-pressure between the frames at right angles to the longitudinal axis of the engine, all driving on to one axle, this axle being coupled to the trailing axle behind the firebox.

The leading end of the engine is carried on a double radial truck the centre of which is fitted with Mr. Webb's radial axle box and central controlling spring. This arrangement permits of one inch side play and gives greater freedom to the truck when passing round curves than is possible in the ordinary type of bogie with a rigid centre pin. Another distinctive feature of this engine is the method devised for working the slide valves—two sets of valve gear only being required for working the four valves.

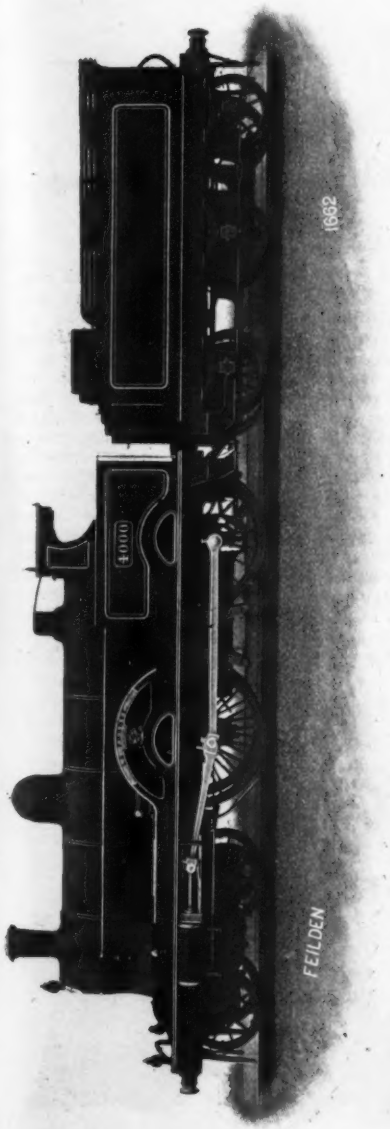
This is accomplished in the following manner:—

The valve motion used is Joy's, which is applied to the low-pressure cylinders in the usual way. The valve spindle of the low-pressure valve is prolonged through the front of the steam chest, and on the end of this spindle a crosshead is fixed having a loose phosphor bronze bush which is free to turn in the crosshead. This crosshead engages with a lever of the first order which is pivoted in such a position as to give the necessary length of travel to the high-pressure valve, the pivot being firmly secured to the frame of the engine.

The opposite end of this lever engages with a crosshead fixed to the front end of the high-pressure valve spindle, which thereby receives its motion from the low-pressure valve spindle. Thus only one set of motion is used for working the two valves. One important object aimed at in the design of this engine has been to get all the bearing surfaces throughout as large as possible. Each of the four journals of the radial truck is 6½ ins. diameter × 10 ins. long. The driving axle, in addition to the two ordinary bearings, which are 7½ ins. diameter × 9 ins. long, has a central bearing between the two cranks 7 ins. diameter × 5½ ins. long. In the trailing axle the bearings are 7½ ins. diameter × 13½ ins. long. The driving and trailing wheels are 7 ft. 1 in. diameter, and the radial truck wheels 3 ft. 9 ins. diameter. The mean diameter of the boiler is 4ft. 3ins., and the length of the barrel 11 ft., the working pressure being 200 lbs. per square inch.

There are 225 tubes, each 1⅞ in. diameter, and the heating surface is, for tubes 1,220·5 sq. ft., and firebox 159·1 sq. ft., giving the total of 1,379·6 sq. ft. The area of the fire-grate 20½ sq. ft.

The total wheel base is 23 ft. 2 ins., the



LONDON AND NORTH-WESTERN RAILWAY FOUR-WHEELS-COUPLED COMPOUND PASSENGER LOCOMOTIVE "LA FRANCE." (F. W. WEBB'S SYSTEM.)

fixed wheel base being 9 ft. 8 ins. The weight in working order is as follows: on the radial truck 18 tons 18 cwts., driving wheels 18 tons, trailing wheels 17 tons 10 cwts.; total 54 tons 8 cwts.

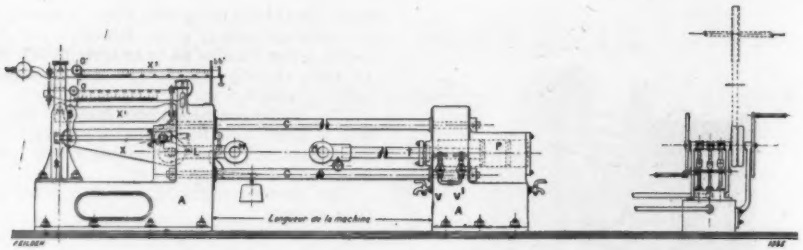
The tender carries 2,000 gals. of water, and is fitted with the water "Pick Up" apparatus, which enables the engine to take water whilst running.

The tender weighs in working order 26 tons 12 cwts.

50-TON TESTING MACHINE.

THE exhibit illustrated on the next page is being shown by the Valère Mabille Co., of Mariemont, Belgium. Referring to the lettering in the illustration, *A* is the cast-iron frame in which is placed a hydraulic cylinder, the piston (*P*) of which forms part of a rod (*T*) which terminates at a head (*M*), to which is attached the testing apparatus. Water is injected into the cylinder by a small three-cylinder double-acting pump, the constant delivery from which gently forces the piston in the direction of the arrow, opening the valve *V* and closing V^1. In order to bring the piston back to its former position the valve V^1 is opened and *V* is closed. On the frame A^1 are attached all the levers of the balance which rests on the support *S*. The piece to be tested is attached to the head M^1, and the arrangement of levers *L*, *x*, *t*, x^1, t^1, x^2, t^2, x^3, transmit the load. When the machine is not in use the sliding piece *O* is at the point *I*, and O^1 is at the point I^1 on the bar x^3 on which are marked the tons, other units being on the bar x^2.

The piece to be tested being placed, it is fixed either directly to the heads *M*, M^1, or if it is too short by the intermediary rod with an adjusting screw, the attachment being made by gripping pieces or other suitable apparatus according to requirements. If water is then injected in front of the piston *P* it is forced in the direction of the arrow and draws on the piece, the equilibrium of the levers is disarranged, and in order to re-establish it, it is necessary to move the sliding weight *O* along the graduated lever x^2, and O^1 along x^2, in order that the two points b, b^1, may remain always at the same height. At the moment of rupturing the test piece the equilibrium of the system is destroyed and the breaking strain is indicated at the point where the pointer of the sliding weight has stopped. The length of the machine may be either 3 or 4 metres according to requirements

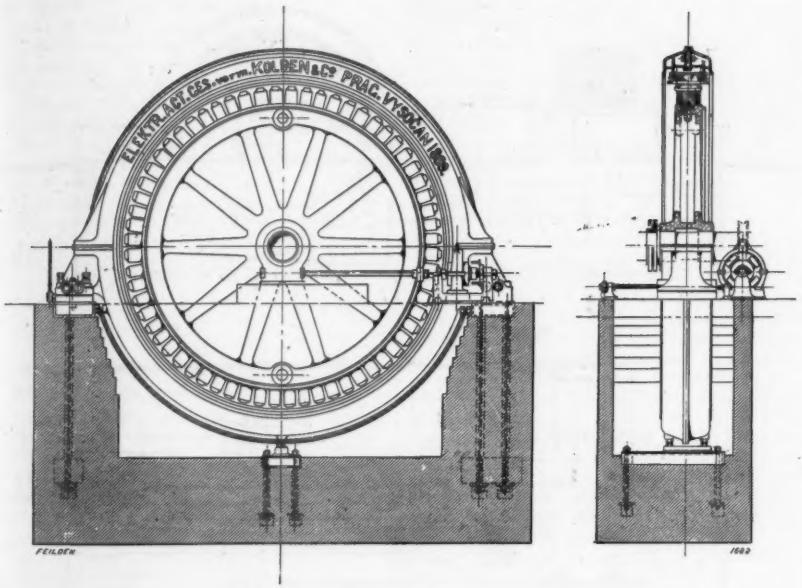


VALÈRE MABILLE CO.—50-TON TESTING MACHINE.

KOLBEN & CO. AND MESSRS. CAREL FRÈRES THREE-PHASE ALTERNATOR.

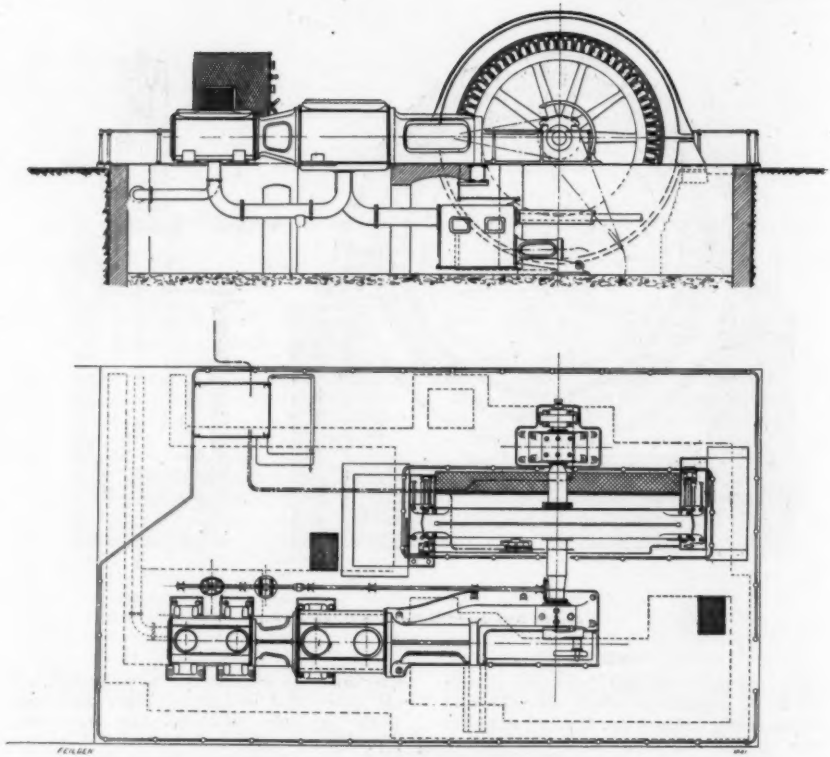
THE first large electric generating unit at the electrical gallery of the Paris Exhibition which was in a position to furnish electric current for lighting purposes was the three-phase steam alternator of the Electricitäts-Actien-Gesellschaft, formerly Messrs. Kolben & Co. It was started on May 2, and both engine and dynamo had been so well tested previously in the company's factory, and so well fitted in place, that from the first day's run the group was able to furnish current for the lighting of "Vieux Paris." The group is situated in the 30 metre gallery, and is devoted to the electrical service of the Exhibition. It is placed at the foot of the large staircase leading from the Palais d'Electricité into the "Galerie des Machines." The engine, which was made by Messrs. Carels frères, of Gand, is a horizontal tandem compound, making 94 revolutions per minute; it drives the flywheel three-phase alternator. This alternator is designed to absorb 1,100 effective h.p. for driving induction motors, furnishing 825 kilo-watts at a compound pressure of 3,000 volts. The rotor has 64 poles, thus generating at 94 revolutions per minute a periodicity of $\frac{64}{2} \times \frac{94}{60} = 50$ cycles per second. The rotor is made in halves, and consists of a heavy cast-iron flywheel carried by 10 double arms, in the rim of which are fitted the cast-steel cores. The weight of the rim is sufficient to reduce the irregularity of the angular velocity to 1,200, having a moment G D 2 = 600,000 metre-kilos, where G is the weight in kilos, and D the average diameters in meters of the revolving masses. The 64

KOLBEN AND CO.—THREE-PHASE ALTERNATOR.



KOLBEN AND CO.—THREE-PHASE ALTERNATOR.

steel cores have an oval cross-section with cylindrical projections which fit exactly in corresponding holes in the flywheel rim, thus reducing the magnetic reluctance between steel and cast-iron in proportion to the different magnetic ratios of steel and cast-iron. The poles of the cores are made of sheet-iron cast into the steel cores. The core winding is made of copper strip of 5 by 25 millimetres ; the single layers are insulated from each other by means of parchment paper punchings. The wound cores are compressed hydraulically. The surface velocity of the wheel is 27 metres per second, the external diameter of the wheel being 5·55 metres. The stator, which carries the high pressure winding, has a laminated iron core with deep slots, which are insulated by micanite troughs. The winding consists of 96 coils, which are laid in the slots and securely fastened. The whole is carried by a strong cast-iron frame, which can be shifted axially, so that single armature coils as well as magnets coils can be easily replaced. The stator frame is also adjustable in a vertical direction by means of heavy adjusting bolts resting upon the cast-iron soleplates. The magnetic proportions of the alternator, as well as the windings, are so calculated that in varying loads only very small pressure variations are noticeable. The dynamo is therefore designed with a high air-gap induction, strong iron saturations, small armature leakage and reactance, having a good pressure characteristic at no load, and a favourable short-circuit curve. The air-gap induction is therefore very high, being 7,500, the maximum rising up to 9,300. The saturation of the steel cores is also very high, going up to 15,500 cub. units per sq. cm. The air-gap is only 5 mm., which means a very excellent workmanship and very strong stator design, in order to prove onesided attraction or even rubbing with such a large diameter of bore as 5½ meters. The armature reaction and self-induction is quite small, as may be judged from the short circuit characteristic. The full load current is already reached at an excitation which produces not more than ⅓ of the normal pressure. The pressure drop at full load, when the alternator is working on lamp-load, is only 5 per cent., and is about 15 per cent. when working on motor-load with a power factor of cost=0·80. The machine works at full load without any



KOLBEN AND CO. AND MESSRS. CAREL FRÈRES.—GENERAL ARRANGEMENT OF ALTERNATOR AND HORIZONTAL TANDEM COMPOUND ENGINE.

humming noise. The dynamo works very smoothly and quietly at full, and even at 25 per cent. over-load ; its total weight, excluding the exciter, is 63 tons.

The exciter for the alternator is a six-polar continuous current dynamo, the armature of which is keyed direct on to the main engine shaft, upon an extension beyond the outside bearing of the engine. It therefore makes only 94 revolutions per minute, and generates a current of 100 volts and 80 to 100 amp. The whole energy required for the exciting is therefore only about 1 per cent. of the useful output.

From the terminals of the alternating three high-pressure main cables lead to the distribution switch-board, on which are mounted all necessary controlling, safety and measuring apparatus. The high-pressure switches of the board are so designed that their manipulation is perfectly safe ; they are operated by the electrician standing upon an elevated platform.

The three-phase current generated by the Kolben alternator is used for the high-pressure distribution cable system of the Exhibition, consisting of two parallel three-wire armoured cables of 2 by 40 mm. per section. The two mains for the transformer stations are in the following parts of the Exhibition :—

1. The Horticultural building.
2. The Quai and the building on the Cours la Reine.
3. The "Palais des Congrès."
4. One part of the "Quai Debilly."

5. The foot-bridge across the Seine.

In "Old Paris" are installed seven Kolben three-phase transformers, which reduce the high pressure of 3,000 volts down to 110 volts; this current is used for both arc and incandescent lighting.

It may be remarked that the alternator exhibited by the Kolben Company is the thousandth dynamo manufactured by this firm. Five alternators, of exactly the same size and output as the one exhibited, are now working at the three-phase central station of Prague, where they are used for generating current for public and private lighting and power uses, and for the electric tramway service.

THOS. ROBINSON & SON, LTD.
WOOD-WORKING MACHINERY.

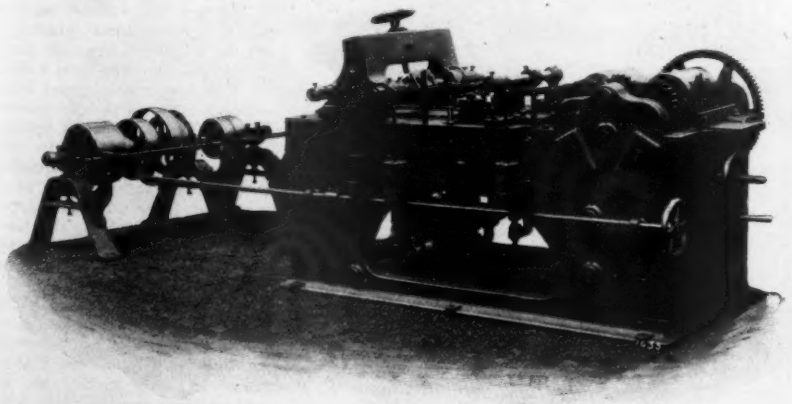
MESSRS. THOMAS ROBINSON & SON, LTD., of Rochdale, have some interesting exhibits of wood-working machinery, conspicuous among which are a planing and moulding machine, a chain-cutter mortising machine, and a patent diagonal dovetailing machine.

The planing and moulding machine is for the purpose of working straight mouldings of any shape in hard or soft timber; also for planing, tonguing, and grooving, or jointing boards and parquetry, operating on all four sides of the timber at once.

The timber is fed into the machine by means of four rollers, each of which is driven by spur gearing, this speed being variable to produce different rates of speed according to the nature of the wood. Four revolving cutter blocks are provided, to which are bolted the cutters which operate on the timber, one on the underside, one on the top side, and two on the edges. The cutter blocks revolve at a very high speed, and are carried in self-lubricating bearings so arranged that the oil circulates continuously through the bearing whilst the cutter block spindle revolves. The machine will work timber of any size up to 6 ins. wide by 2½ ins. thick, and at a maximum rate of feed of 50 ft. per minute. The power required to work it is about 12 b.h.-p.

The chain-cutter mortising machine is for cutting mortises for all kinds of woodwork in either hard or soft timber. Its special feature is the great rapidity with which it does its work. The mortises are cut by means of a series of cutters formed by the links of an endless chain, which is driven at a high speed by a sprocket wheel which supports its upper end. The lower end of the chain passes round a friction roller running in a ball-bearing, and mounted on the end of a guide-bar, which is adjustable in order to give the requisite tension to the chain.

The timber is cramped to a table, which is stationary during the operation, but can be adjusted in height by hand-wheel and screw for different sizes of timber. By pressing the foot on a treadle the chain-cutter descends into the timber and cuts the mortise at one operation. As it enters the wood it throws out all the chippings, and so dispenses with the necessity of core drifting.



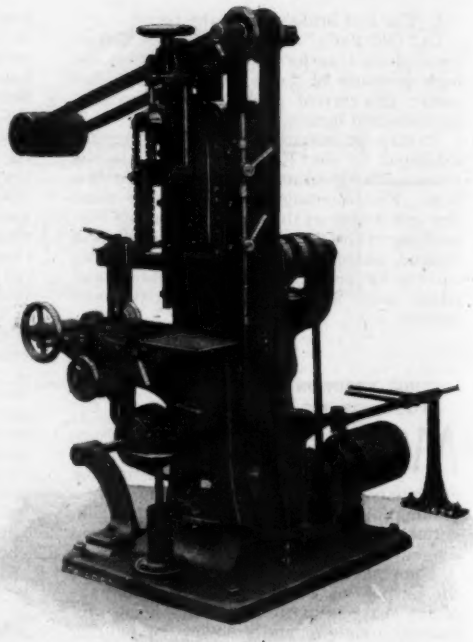
THOS. ROBINSON AND SON, LTD.—PLANING AND MOULDING MACHINE

For different mortises chains and guide-bars of different widths are required. The cutter-chain can be sharpened by an emery wheel mounted on a simple apparatus specially designed for the purpose. The machine, which requires about 6 b.h.-p. to drive it, takes in timber of any size up to 12 ins. deep by 6 ins. wide, and cuts mortises up to 1 in. wide.

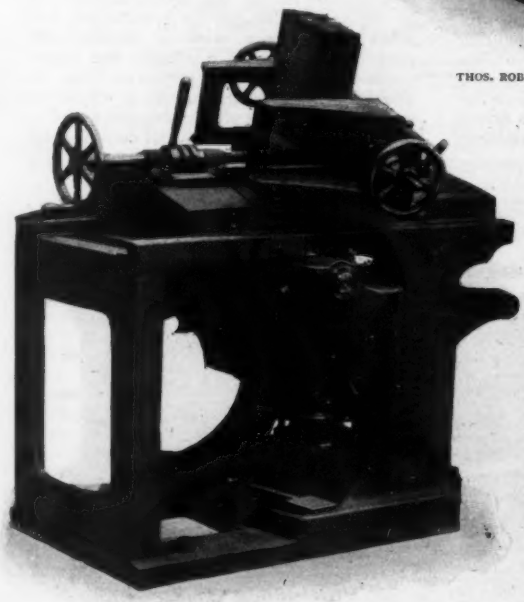
Young's patent diagonal dovetailing machine, which is specially recommended for the making of ammunition, fish, or mineral-water boxes, cuts a series of diagonal notches in the edges of boards to form an improved joint of exceptional strength for the sides and ends of wooden boxes in place of dovetailing. The machine has a very large capacity, as it operates on several boards at one operation.

The boards are clamped together against a fence on a travelling table, and are traversed by means of an automatic feed over a series of cutters mounted on a horizontal shaft, which can be raised or lowered for adjusting the depth of the notches formed by the cutters. The latter gradually vary in diameter, so that their outer edges together form a cone which imparts the diagonal form to the notches. The feed motion of the travelling table is started in a forward direction by the pressure of the foot on a treadle, and is instantly reversed at a quick speed on its removal, so that the working of the machine can be entirely controlled by the operator's foot, leaving the hands free.

Notches in a maximum width of board of 12 ins. can be cut at one operation, but by removing the side-guides on the table, boards of any width can be notched by re-passing them over the cutters one or more times according to the width.



THOS. ROBINSON AND SON, LTD.—CHAIN-CUTTER MORTISING MACHINE



THOS. ROBINSON AND SON, LTD.—YOUNG'S PATENT DIAGONAL DOVETAILING MACHINE.

MESSRS. A. HERBERT & CO., LTD., COVENTRY—MACHINE TOOLS.

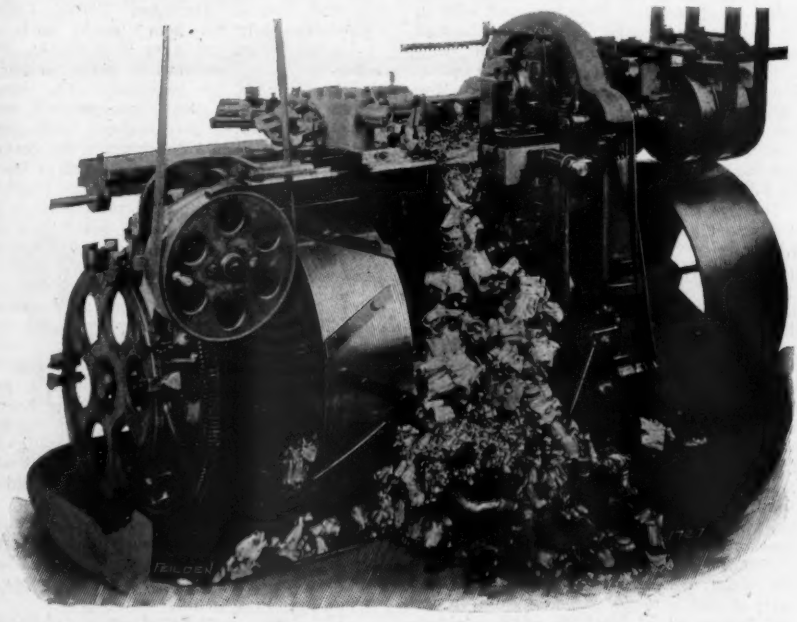
An exhibit which is likely to attract considerable attention is that of Messrs. A. Herbert & Co., Ltd., of Coventry, a firm who have evidently spared no pains to make machine tools of British manufacture as good as—or, perhaps, better than—those of any other country; and there is no doubt about their having succeeded.

The very fine stand of this firm, which is situated in the Machinery section of the Champ de Mars, well repays a visit, as the variety of design and the numerous movements introduced into their specialties are a revelation in automatic machine-tools, and to those interested offer a splendid opportunity of seeing what can be done by accurately adjusted movements adapted to labour-saving machines; since here, in marked contrast to many others, their exhibit is in running full order.

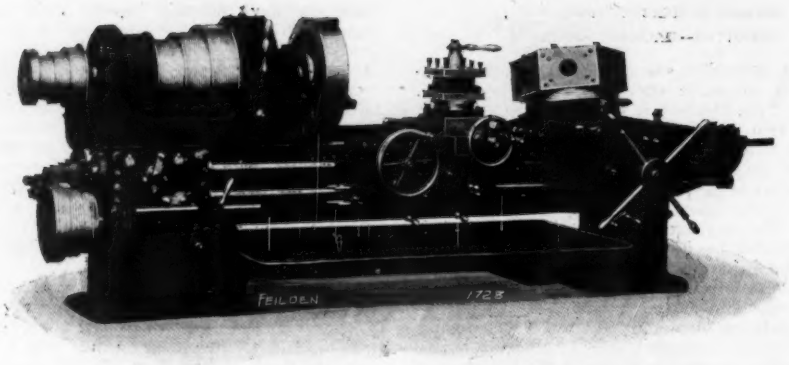
The illustration below shows what is termed a No. 4 Full Automatic Screw Machine, but which is capable of turning out such a variety of work that its title scarcely does it justice. This machine at the present time may have the most interest as, in conjunction with a smaller size, it is identical with those engaged in making the 1-pounder and 6-pounder quick-firing shells at the works of Messrs. Vickers, Maxim & Co. of Erith, Armstrong, Whitworth & Co., and others. For this particular class of work special forming and cut-off slides are provided, and the various time-motions are formed by strips of hardened steel, fixed on the periphery of the cast-iron drum seen on the left of the illustration.

This method of arranging time-motions is decidedly preferable to some we have seen on other machines made for similar purposes, inasmuch as it obviates the making of complete former cams, which have to be cast, machined, and then filed on their edges, to give the exact amount of movement required, and with the disadvantage that with every change of work a fresh pattern must be made, as any alteration at once destroys its originality.

There is also shown a No. 0 screw machine, which is generally used for making small screws or studs, its limit being work about $3\frac{1}{4}$ ins. long by $\frac{3}{8}$in. diam., a larger machine being used in conjunction with another of



MESSRS. ALFRED HERBERT AND CO., LTD.—FULL AUTOMATIC SCREW MACHINE.



MESSRS. ALFRED HERBERT AND CO., LTD.—HEXAGON TURRET LATHE (NO. 6).

the same kind in producing screwed studs from the black or bright drawn bar by the following operations.

The bar passing through the spindle is gripped in an automatic chuck, and the projecting portion is then turned to size, and ended simultaneously, by a box tool held in the turret of the machine; screwing the stud by another tool, and then parting off, complete the first operation. The second operation, which finishes the stud, is done on the companion machine, provided with the magazine or hopper attachment; the partially-finished stud falling into position, is pushed into the chuck, screwed, and then ejected by the following piece.

The screwing of work on these machines is done at a rate of about one-fifth that of the turning, and it is in the variation of the speeds at different periods of the machine's operations that Messrs. Herbert have produced excellent results, as they were satisfied that the most essential feature of automatic machinery was the variable rates of cutting, so that the different operations should be performed at speeds which were consistent with the best classes of work with the minimum amount of wear on the tools. The magazine attachments are of different forms and sizes to accommodate the several pieces in the form of castings or cropped off pieces, or such as have passed through one or more stages. Such an arrangement ensures a constant supply without any appreciable loss of time for each successive operation; whilst the entire working of the machine, all the parts of which move in perfect unison and with mathematical precision, at once demonstrates the futile efforts of handwork in comparison with the rhythmical motion which produces piece after piece without the *interruption* which is a factor that cannot be eliminated from the labour of individuals.

A fine piece of workmanship, forming a striking contrast to the auto-screw machines, is the No. 6 Hexagon Turret Lathe, specially built for heavy work, such as cylinder covers, valves or gear blanks, and longitudinally for spindles, etc., on which square threads are required. The headstock is of very strong construction, provided with a rapid change-speed mechanism enabling the operator to change the cutting speeds at will, whilst by a system of back-gearing and an arrangement on the countershaft, combined with the variations to be obtained on the cones, it is possible to get no less than 18 different speeds. The spindle is of mild steel, on which is forged the flange carrying the chuck. It has a $2\frac{3}{8}$ ins. hole through its entire length, and revolves in heavy phosphor-bronze bearings, provision being made for taking up any back-lash or end-play. The main turret, seen on the left of the machine, is of massive proportions, hexagon in form, and measuring $18\frac{1}{4}$ ins. across the faces, and each face $10\frac{1}{2}$ ins. by $7\frac{1}{2}$ ins. It is perforated with tool holes $3\frac{1}{4}$ ins. diameter; there is also provision made on the faces for holding tool boxes or cutter heads.

The rotation of the turret is by hand, which is found more satisfactory on a heavy lathe than an automatic movement, as it allows the several tools to be brought into operation alternately or otherwise.

The turret is mounted on a saddle, the slide of which is arranged so that 18 different

feeds can be obtained, the whole of them automatic, and ranging from a fine one suitable for drilling steel to a very coarse one used for taking a roughing cut through cast iron, in which the hole to be finished has been previously cored.

The feeds are regulated by independent stops, and are also reversible.

An auxiliary turret fixed upon a second saddle has a separate series of feeds and tools, together with a chasing mechanism for cutting internal or external threads.

A patent chasing saddle-lathe is shown, the main features of which consist of a turret with independent stops, this being a great advantage, as it obviates the trouble of setting tools in a relative position, as in a turret without these stops the tools have frequently a great amount of projection or overhang, and consequent weakness. The arrangement of these automatic stops enables every tool to be set close into the turret, the adjustment being made by movable pieces.

A plan of the stop mechanism is shown below, where the stops are set at the required distances on a hexagon bar, the number of flats on this coinciding with the number of tools in the turret, and the stops used in connection with them.

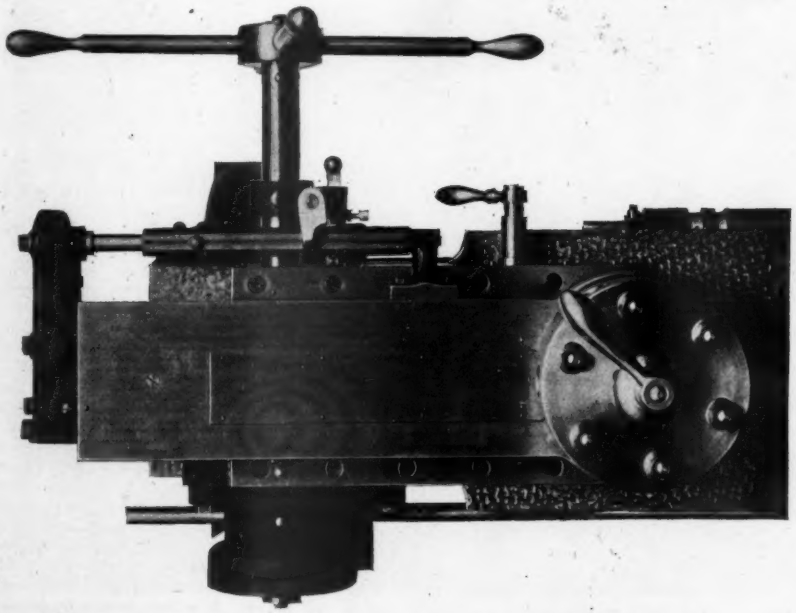
The chasing saddle has a patented arrangement, by which the tool is set in its cut, and withdrawn by the same movement which engages and disengages the nut from the leader, the cut being put on independently by means of the hand-wheel; as the leaders are removable, this arrangement enables very quick and accurate threads to be cut, and altogether avoids the possibility of cross-threading. Each leader will cut *four pitches*, the change for the different ones being made by means of the lower of the small levers on the feed-gear box on the extreme left-hand of the bed.

The upper of the two levers is used for reversing the movement of the leader for right and left-hand screwing.

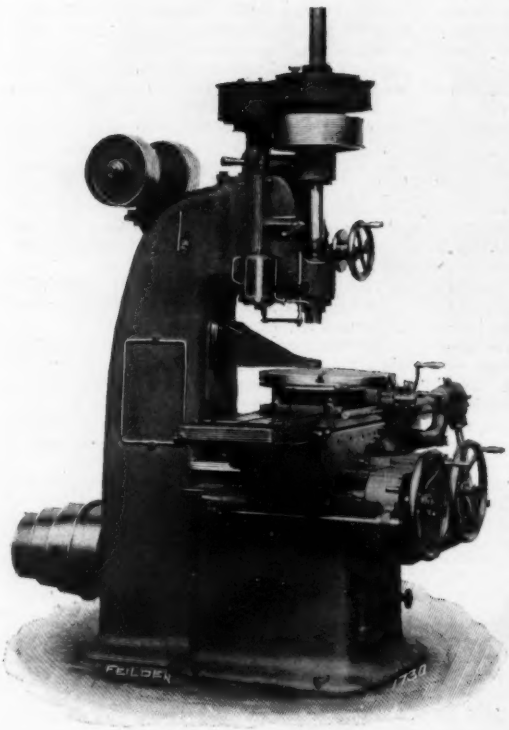
The automatic feed to the turret-slide has six changes, graduated from fine feeds for boring and turning hard steel, down to coarse feeds for cast metal or cored holes.

The illustration on p. 334 shows a vertical milling machine, several prominent points distinguishing it from other makes.

In the first place the spindle is balanced and its vertical movement provided with a micrometer adjustment, which permits of the cutter being lowered to a definite depth. The pull on the spindle is avoided by a



MESSRS. ALFRED HERBERT AND CO., LTD.—STOP MECHANISM OF CHASING SADDLE LATHE.



MESSRS. ALFRED HERBERT AND CO., LTD.—VERTICAL MILLING MACHINE.

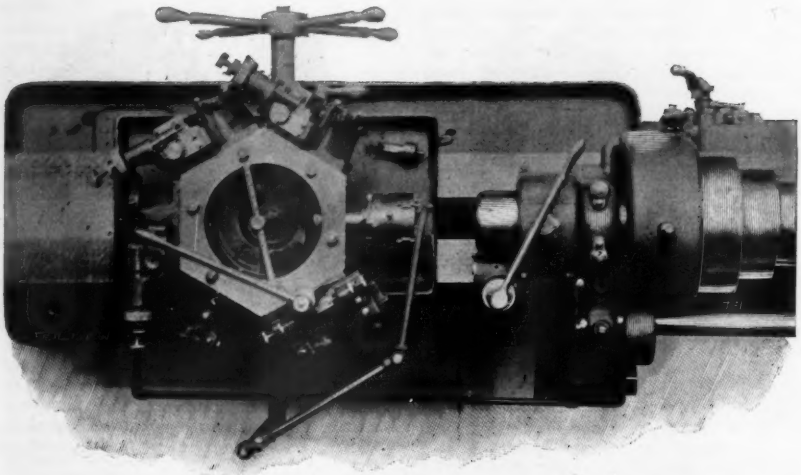
special drive, thus reducing any tendency to lateral wear. A long platen, firmly supported in well-proportioned slides, carries a removable circular table, provided with both hand and automatic feeds, and also automatic stops which throw out the feeds at any desired point. The removal of this table in no way interferes with the rest of the feed mechanism of the machine.

Two other excellent features are that all gearing is enclosed, and the handles and hand-wheel face the operator and are under his immediate control. In concluding our references to Messrs. Herbert's tools, we must not omit to notice a machine designated No. 2, a patent Hexagon Turret Lathe, a plan of the turret of which is shown on page 335. This machine combines so many conspicuous qualities that by the arrangement of special tools used in the turret it seems capable of turning out work of illimitable design, upwards of three dozen specimens of work being shown in connection with it.

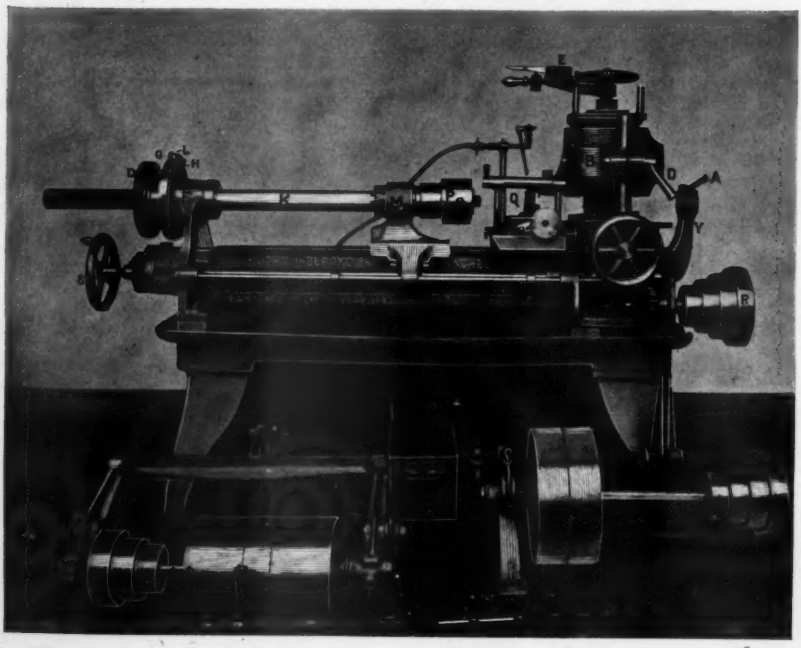
MESSRS. J. HOLROYD & SONS—MACHINE TOOLS.

At the stand of Messrs. J. Holroyd & Sons, Rochdale, may be seen quite an innovation in the new screw milling machine, which is the invention of Mr. H. Liebert, managing director of the firm. This machine at its inception was intended to supersede the screw-cutting lathe in the making of the coarser kinds of screws, but was found after a few trials to be capable of producing work of a very accurate description, and without the attention of skilled labour, an operation in an engineering shop that has hitherto been a failure; so that Mr. Liebert must at least be complimented upon his achievement, as it is possible for a man of ordinary intelligence to operate four or five of these machines, whose output exceeds that of as many lathes.

The machine is illustrated on pages 335-6, and consists of a bed 5 ft. in length. The head for carrying the milling cutter is shown at *B*, which has a cross movement and a rotary movement for giving the cutter its position and the angles of the thread. The square groove is completely cut out in one operation. There is also a quick-lifting motion, *E*, for raising the cutter immediately out of the screw or putting it back to its proper depth at once. The vertical slide, *A*, has also a stay, *C*, and *B* can be locked into position by the handle, *D*. The cutter is driven by 2-speed pulleys 7 ins. and $5\frac{1}{2}$ ins. diameter for a 2 ins. belt, and the gears are of gun-metal. The cutter spindle is of hardened cast steel, and runs in hardened conical bearings adjustable for wear. These bearings are lubricated with a solid lubricant. The rod to be screwed is put through the hollow tube, *K*, which is supported by a fixed bracket, *F*, at the left end of the machine and by the sliding bracket, *M*. The bracket, *M*, is connected to the guide-screw by the nut, *N*, which moves by means of the cam pulley, *R*, at the right end of the



MESSRS. A. HERBERT AND CO., LTD.—TURRET PLAN OF HEXAGON TURRET LATHE (NO. 2).

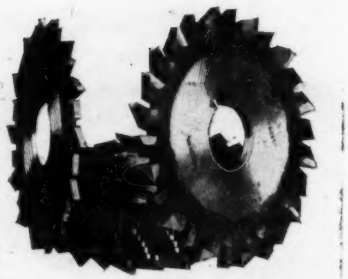


MESSRS. J. HOLROYD AND SONS.—SCREW MILLING MACHINE.

bed. The guide-screw can also be moved by the hand-wheel, *S*, and the work adjusted by the movement of the slide bracket, *M*. At the end of *K* is the chuck, *P*, by which the work is fastened; the rod to be screwed rests on a V support, *Q*, which can be adjusted vertically and horizontally, and is held down in this by the rod, *B*, and by the eccentric shaft, *V*, and lever, *T*. There is a disc, *H*, with a feathered key attaching it to *K*. There is another disc, *G*, with a catch, *L*, so that it may grip *H* and drive it with *K*. This disc, *G*, is attached to the change-wheel, *D*, and when the wheels in gear with the guide-screw are put into gear with *D*, *K* is automatically driven. The disc, *H*, has division notches in it, and by this means screws with any number of threads can be cut.

The cutter which we illustrate, opposite, is stamped out of cast sheet steel, and can be produced at a low cost; the teeth are bent to give clearance, and are ground on the back like ordinary slabbing cutters, and keep their width owing to the set being put on parallel to the sides of the cutter. The operation is as follows:—

The head holding the cutter is put to the correct angle, and over the centre of the rod to be screwed, and then it is regulated for depth. The rod is then firmly gripped by the chuck *P*, and the part to be cut rests on the V support. The cutter then cuts the

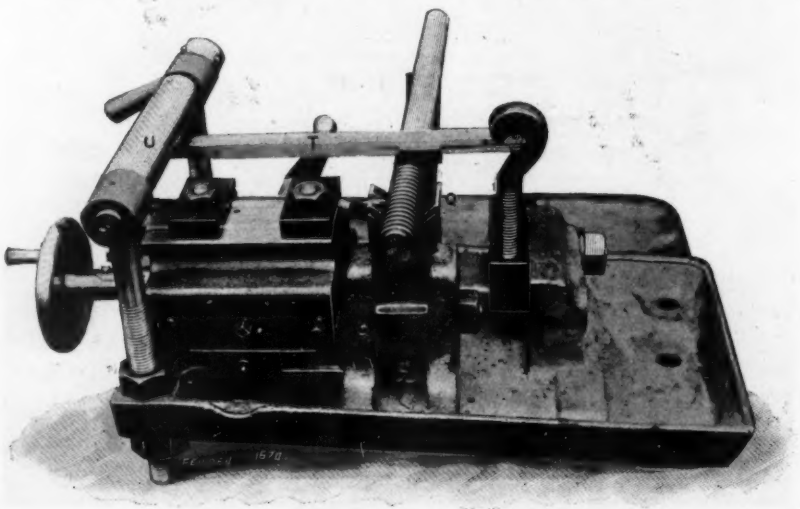


MESSRS. HOLROYD AND SONS.—NEW PATENT CUTTERS, STAMPED OUT OF CAST STEEL.

groove to its full depth and makes the full length of screw required, the bracket on carriage *M* moving the knock-off rod shown in front of the guide screw, thereby stopping the feed.

The head is then raised by *E* and the reversing clutch put in action, which makes the work run back. The work is then taken out, and the new piece put in the chuck *P*.

Should the length of the rod to be screwed be longer than the range of the machine, the bracket *V* comes into use. The rod is first screwed as far as it will go, the end of the rod projecting through the hole in

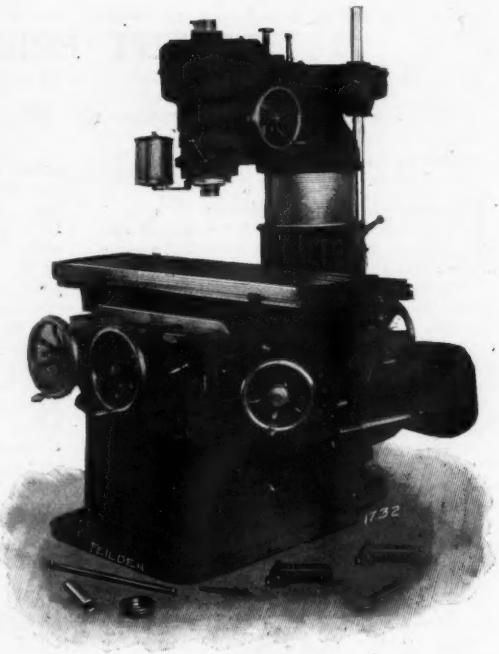


GRIP LEVER FOR HOLDING WORK IN MESSRS. HOLROYD AND SONS' SCREW MILLING MACHINE.

bracket *Y*. The machine is then stopped, and *Y* is made to grip the work firmly by means of the handle *A*, and the chuck *P* is opened out and drawn back as far as necessary, and the rod gripped by it at a new place.

The handle *A* is then unfastened, the machine started, and the remainder of the screw cut.

The screw thread is not quite square, as it cannot be made so from a milling cutter, but it is near enough for ordinary work. If a thread is wanted with quite square and polished sides, then the turning tool comes into operation, being used at the same time as the milling cutter.



MESSRS. BROWN AND SHARPE CO.—VERTICAL SPINDLE MILLING MACHINE (NO. 6).

BROWN & SHARPE CO.

THE most noticeable improvements made by this firm on their machines are the following:—On the No. 5 vertical milling machine, the cross slide is provided with a centre bearing which gives additional support under the table, and is also used to take up any lateral wear, the surface wear being adjusted by strips located on the outer edges of the slide. For the cutter spindle a positive drive is obtained by the use of chain gearing. The cutter can be elevated or depressed for a $\frac{1}{1000}$ of an inch, by means of a finely graduated hand-wheel, and the feed is made more positive by means of a universal joint, shown at the bottom on the right, which has superseded a strap drive.

The feeds of the table are positive and automatic in either direction.

The longitudinal feed is 52 ins. long, the transverse 12 ins. long, and both can be automatically released at any point. There are sixteen changes of feed for each direction, obtained by means of change gears; varying, with back gears in position, from ·006 in. to ·66 in. without back gears in position, from ·001 in. to ·110 in. to one revolution of spindle for each direction.

A fine hand-feed for the longitudinal and traverse movements of the table is operated by the hand wheel on the right-hand side of the machine; and a dial, graduated to read to thousandths of an inch, indicates the movement.

The two hand wheels on the front of the machine operate the coarse feeds of table, and are provided with dials graduated to read to $\frac{1}{64}$ of an inch.

(To be continued.)

RECENT BRIDGES.

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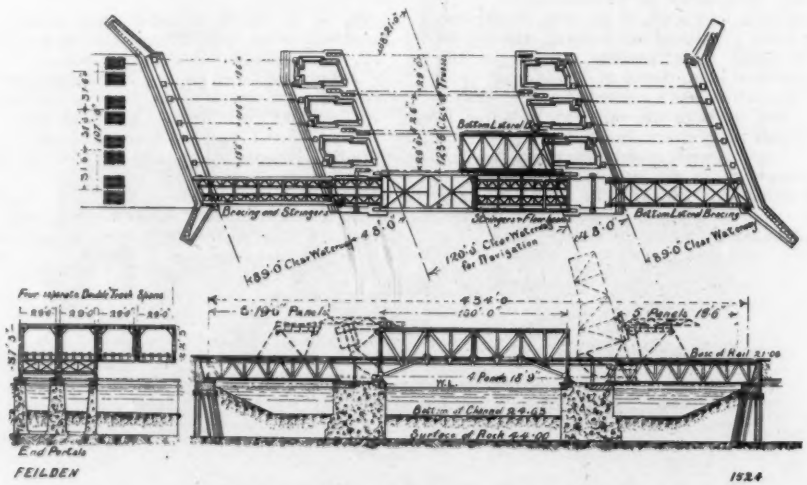
EIGHT-TRACK ROLLING LIFT BRIDGE AT CHICAGO.

THE tendency to adopt bascule bridges or structures of a similar pattern is becoming less and less owing to objections arising from the large area of the structure that is subjected to wind pressure when the sections are raised to a vertical position. A conspicuous example, however, of a rolling lift bridge occurs in the recently-completed structure carrying eight sets of rails over the Chicago drainage and ship canal. The conditions were such as to render a movable bridge a necessity, as the dimensions of the waterway, which is one of the greatest artificial highways ever constructed, are such as to accommodate the largest of steamers now navigating the Great Lakes. During the construction of the waterway fixed girder plate spans sufficed to carry the railways, as the channel was then only of sufficient dimensions to permit the passage of tugs and barges used in connection with the construction.

The problem of carrying eight railway tracks by means of a movable bridge capable of accommodating the requirements of navigation was by no means an easy one, and it was decided to invite competitive designs. That eventually selected by the Sanitary District of Chicago, and approved by the railway companies interested, was submitted by the Scherzer Rolling Lift Bridge Company, and a contract was entered into for the construction in August, 1898, the work of the substructure being finally completed in January, 1900.

The bridge, which provides a clear waterway for navigation of 120 ft. between the piers, crosses the canal at an angle of 68 degs. Parallel to the centre line of the channel, and on each side of the waterway provided for navigation, is placed a main supporting pier 48 ft. in width. These foundations are in bed rock 44 ft. below the city datum, and to reduce the masonry to a minimum, the piers are constructed with four cavities in each. Coffer-dams were built on each side, and the area for excavation pumped dry. The material used in the erection of the piers and abutments is Portland cement concrete, the former being capped by four 2-ft. courses of Bedford stone, and the latter faced and capped.

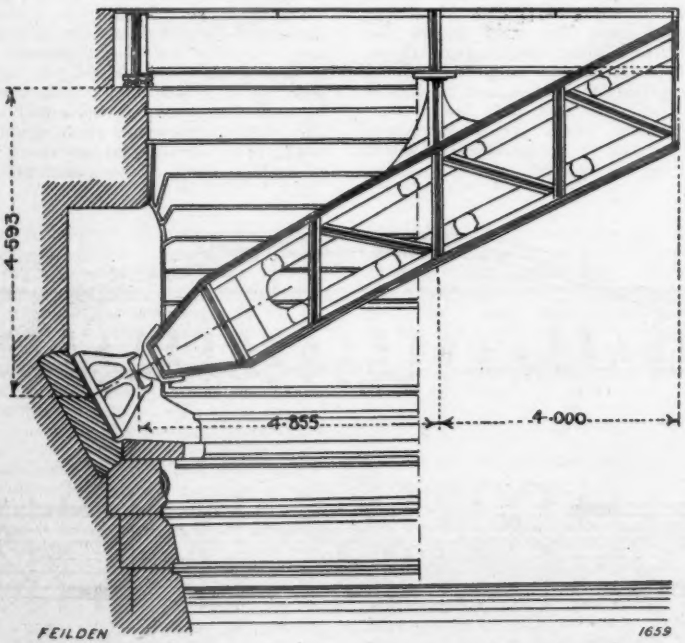


EIGHT-TRACK ROLLING LIFT BRIDGE AT CHICAGO.

The concrete was mixed by machinery, and was composed of one part of cement, three parts of sand, and six parts of broken stone, deposited in 6-in. layers and thoroughly rammed.

The superstructure consists of four independent double-track rolling lift bridges running parallel with a clearance of 6 in. between the adjacent trusses. The movable spans are designed as three-hinged arches, and they may be operated jointly or singly, as desired, by two operators, one on each side of the canal. For the present, however, the spans will be arranged as a fixed bridge until the requirements of navigation call for a movable structure.

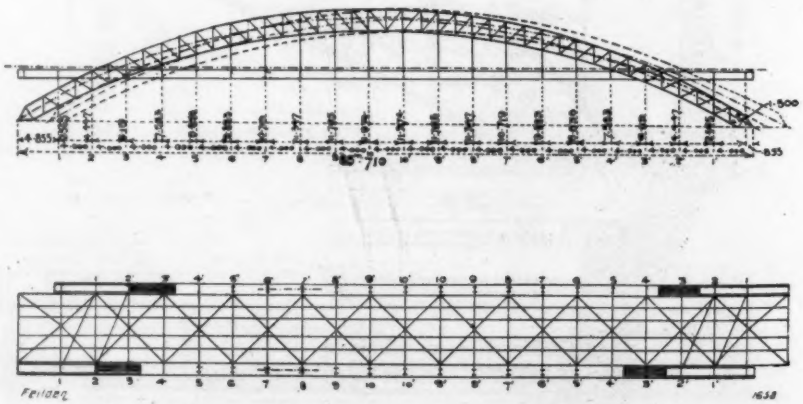
When the bridge is to be made movable, the track girders, rolling segments, operating struts, machinery supports, machinery and electrical equipment will be added. These latter features are indicated by the dotted lines in the elevation which shows the bridge complete for operation as a movable structure. When it is desired to open the bridge, the centre pins are unlocked by means of electrical devices, the spans are then rolled upward and backward on the track girders as shown on the right of the elevation for a semi-span. The rolling segments, the track girders, and the operating struts are clearly shown in the drawing. The movable spans are counter-weighted, so as to be at rest at an angle of about 40 degs. This greatly facilitates the opening of the spans, and also aids in closing them. The bridge is to be opened or closed in 30 secs., by means of four 40-h.-p. electric motors on each side of the channel. The electric motors are governed by a controller in an operator's house, placed on each side of the channel on the machinery support, at an elevation sufficiently high to command a clear view of the railroad tracks and the channel. A channel back of each of the main piers is provided to give to the canal a capacity sufficient to take the maximum flow of water required for drainage purposes. These channels are spanned by fixed approach spans, which carry the machinery supports, provided to carry the operating machinery.



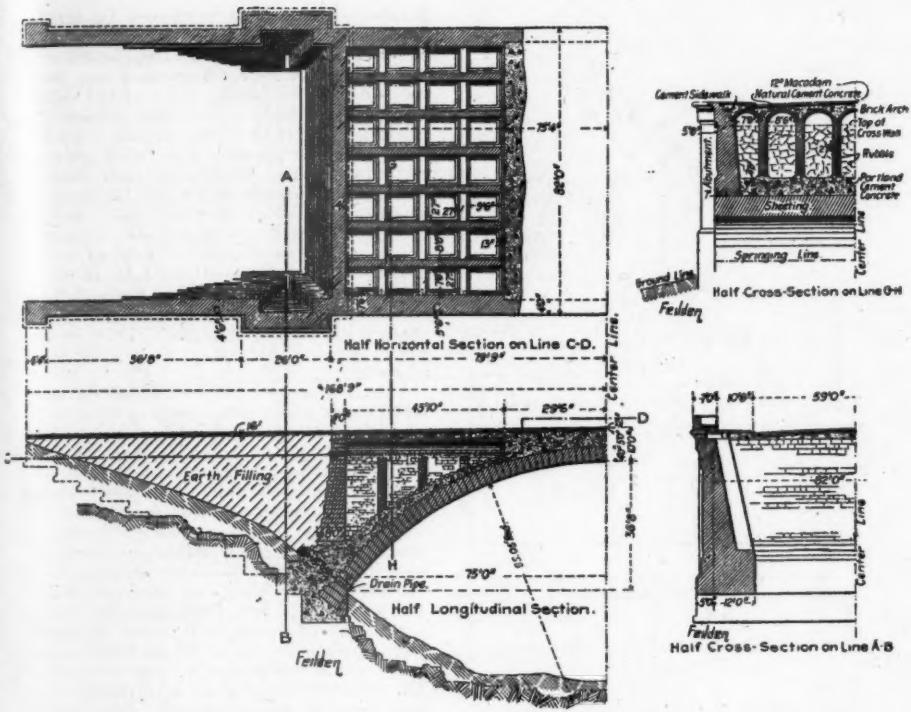
BRIDGE OVER THE SEINE: DETAILS OF GIRDER BEARINGS.

AN INGENIOUS BRIDGE.

THE bridge across the River Seine, of which a full view is given in our supplement plate this month, forms part of a viaduct carrying the railway from Courcelles to the Champ de Mars over the two arms into which the river is divided by the Ile des Cygnes. It was constructed by the Compagnie de l'Ouest to render direct access to the Exhibition, without change of cars, possible both from the St. Lazare Station and the Gare du Nord. The opening of this auxiliary line took place on April 17th. The viaduct above referred to contains many details of interest, the most important feature being the bridge described below, which crosses the larger of the two arms of the river. Its construction presented a problem of some intricacy, and rendered the adoption of a special type of bridge necessary, for, while on the one hand the exigencies of navigation placed the sinking of piers out of question, as they would have formed an obstacle to the river traffic, on the other hand a platform raised above a single arch was impracticable on account of the comparatively low level of the Invalides-Molineaux line, with which a junction is effected almost immediately after the train leaves the bridge. After some deliberation, therefore, it was decided to adopt a modified form of suspension bridge, and to choose a type similar to that of a bridge constructed a few years previously across the Kiel canal at Grunenthal, in which the flooring is placed about midway between the springings and crown of the arch, so that in the central portion this flooring is suspended from the arch, while at its extremities it rests upon the arch. The bridge, which is constructed for two lines of rails, consists of two crescent-shaped trellis girders of 85 m. 712 span. The curve of a parabola, with a rise of 12 metres throughout the centre span, has been adopted as giving of all forms the greatest rigidity and reducing to a minimum the flexure of the trusses. The arched girders rest by means of roller bearings of steel upon steel supports having a broad base, so arranged as to insure a uniform distribution of pressure upon the masonry work. The central portion of the platform is suspended from the arches by means of solid rods 4 metres apart, which are very wide in a direction transverse to the bridge, while in a longitudinal direction they are rather slender and possess great elasticity, rendering possible a longitudinal stretching of the flooring without communicating any heavy strain to the arched girders. In the neighbourhood of the abutments the platform rests on the tie girders of the arches by means of sliding plates, and the arched girders have a width of a metre, which gives great rigidity in a transverse direction. Throughout the central portion, wherever the height permits it, the arched girders are united two and two by vertical tie-pieces of trellis work, and by a double system of horizontal bracing. The platform possesses great rigidity, consisting of a system of solid bars strong enough in itself to resist all horizontal pressure of



BRIDGE OVER THE SEINE: GENERAL ELEVATION AND PLAN OF THE ARCH.

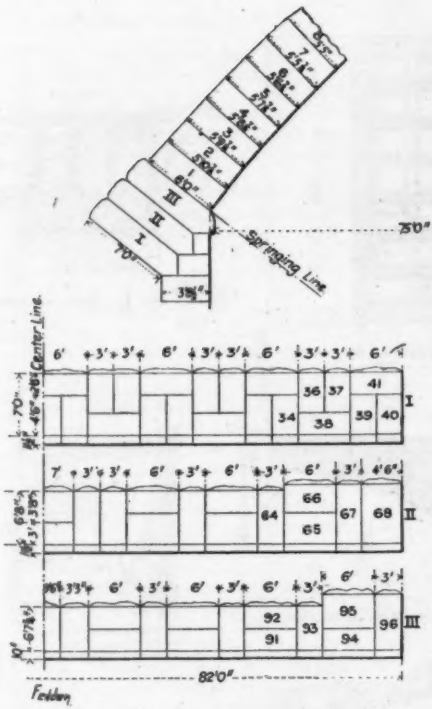


BELLEVILLE STONE-ARCH BRIDGE: GENERAL DETAILS OF MASONRY.

the wind, without counting the resistance of the flooring of solid metal which prevents all transverse deformation of the bridge, be it by wind-pressure or through the passing of a train. As unsymmetrical pressure on the bridge is apt to result in deformation of the arch and in displacing the crown, the suspension rods would be bent out of shape if the platform attached to them were rigidly keyed to the abutments. To avoid this the central portion of the platform is rendered movable in a longitudinal direction by means of a roller device and follows the displacement of the arch, its centre remaining directly below the crown, and the suspending rod supporting it being prevented from bending. In the construction great care has been taken to adapt it to every possible kind of stress. The total weight of the structure, exclusive of the cast-metal railing, is 872 tons, or about 9,720 kilogrammes per running metre. The mounting of the trusses was accomplished from scaffoldings previously erected, beginning with the placing of the arches, starting from both banks simultaneously, and as soon as the arched girders were in place the supports were put in position. Notwithstanding an unfavourable season there occurred no delay in the erection of the structure, and, though not begun before November, 1899, it was entirely completed on March 15th, 1900.

THE BELLEVILLE STONE-ARCH BRIDGE, PITTSBURGH.

THE third bridge that we shall consider in the article is one of masonry, presenting many interesting features—for details of which we are indebted to *The Engineering Record*, New York. The bridge carries a highway 70 ft. deep across a ravine at the main entrance to Schenley Park, Pittsburg, U.S.A. The bridge is 341 ft. long, and has



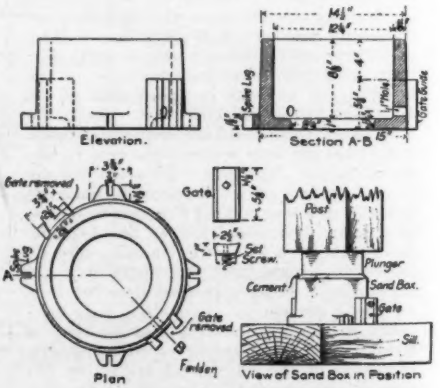
BELLEVILLE STONE-ARCH BRIDGE: FOOTING AND ARCH COURSES.

an extreme width of 85·5 ft. The arch consists of a segmental span of 150 ft. having a clear rise of 35 ft., the width across the soffit being 82 ft. The bridge carries a 59-ft. roadway, and two 10-ft. sidewalks.

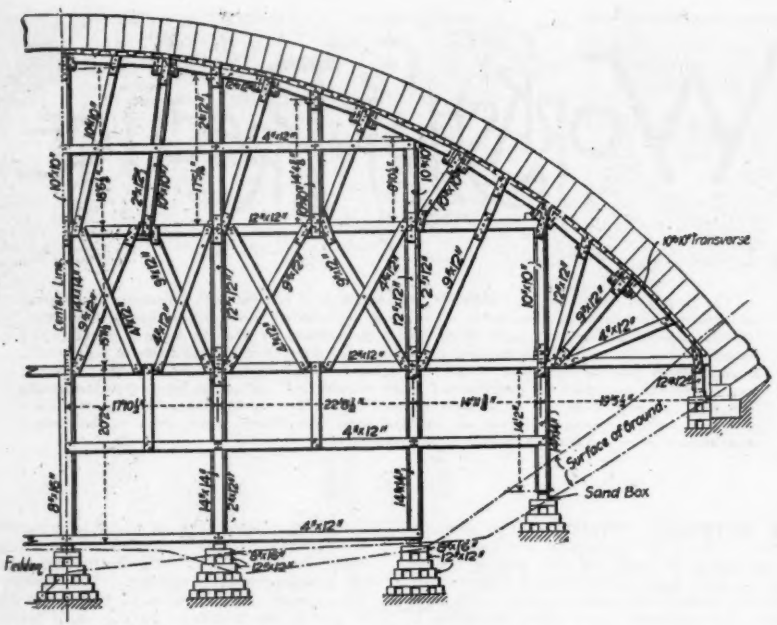
The foundations, which are in solid rock, consist of concrete, the first of the footing courses containing 41, the second 39, and the third or skewback course 27 stones. The voussoirs are laid up in 42 courses on each side of the keystone, and to a distance of 7 ft. from the faces of the walls have depths of 4 ft. at the crown, increasing gradually to 6 ft. at the spring.

The extrados of the arch is covered with concrete, the thickness of which diminishes from 4 ft. at the springing lines to 18 ins. at points 30½ ft. each side of the centre of the span where it has a maximum thickness of 8 ft. and a minimum of 5 ft. at the crown. At each end of the bridge, above the springs, there is a transverse retaining wall running parallel to and being reinforced by three cross walls. Six spandrel walls, 27 ins. thick, intersect these, all of them being seated on steps formed in the concrete filling over the voussoirs. The retaining and spandrel walls are of rubble, built in horizontal courses of stones not less than 2 cub. ft. each. From the tops of the spandrel walls brick arches are turned. The head walls, piers, wingwalls and abutments are of grey sandstone masonry, the head and wingwalls being backed with rubble. The concrete filling on top of the brick arches is finished with Portland cement, mortar and ⅜ in. of rock asphalte pitched to drain to the backs of the retaining walls, whence the water is discharged through iron pipes. There is a 12 in. wooden pavement on top of the asphalte.

The arch centres call for a somewhat detailed notice. There were fourteen falsework ribs 6 ft. 2 ins. apart, braced together transversely and built of hemlock. Each of the vertical posts was rounded at the bottom to make a cylindrical plunger which fitted closely inside a cast-iron sand-box, shown in one of the cuts. The boxes were bottomless, except for a horizontal flange with slotted lugs, through which they were spiked to the foundation sills. They were filled with dried and sifted sand, on which plungers were seated, and then cemented around the tops of the shells so as to seal the sand and keep it dry and in condition to be removed easily. The cylinders were 12 ins. in diameter, except those in the centre row, which were 14 ins.



BELLEVILLE STONE-ARCH BRIDGE: DETAILS OF SAND BOXES.



BELLEVILLE STONE-ARCH BRIDGE: BETAILS OF CENTRES.

The lagging was composed of 6 in. × 10 in. planks, not laid close together, as is customary, but separated 2 ft., centres to correspond with the thickness of the voussoirs, so that one lagging piece came under the centre of each course. The segmental caps which supported the lagging were set on top of the vertical and inclined posts, and secured to them by scabs, like ordinary falsework caps. They formed short chords of the curve of the intrados, but were left straight, and not cut to conform to the arc, as is customary. The lagging was wedged up on them to the required position. This resulted in some trouble, and made it necessary to do more trimming on the intrados than would otherwise have been necessary. Before commencing to set the voussoirs the falsework was carefully inspected and levelled up with oak wedges.

The extrados were left as rough as possible to improve the bond with the concrete, and each course was thoroughly grouted. Several cracks from $\frac{1}{16}$ in. to $\frac{5}{16}$ in. thick opened between the courses during construction, owing to the settling of the falsework. They were carefully grouted, however, before the centres were struck. The gradual lowering of the centres was commenced at the centre by opening the slides in the sand-boxes, and scooping out a little of the sand. The process was continued to the ends of the arch until the sand was all removed, and the centring clear of the masonry. There was a total settlement of 0·2105 ft., which left the soffit at the crown ·0372 ft. lower than had been calculated, the crown being set 2 ins. above the required finished height.

SOME OF THE WORLD'S GREATEST EXPERTS in every branch of industrial activity and scientific research are writing special articles for forthcoming issues of **FEILDEN'S MAGAZINE.** A wealth of other valuable matter will be published.

WORKSHOP PRACTICE

The purport of this section of FEILDEN'S MAGAZINE is to give the skilled mechanic in our great industrial establishments an opportunity of bringing his practical ideas and experience into print. Inventive capacity and careful thought on the part of the workman is what we desire to encourage and foster. To this end we invite skilled mechanics, foremen, under-foremen, and heads of departments, to communicate practical suggestions, which, if accepted, will be suitably paid for. Wherever possible, drawings should accompany the contribution; rough sketches will suffice, as, when draughtsmanship is at fault, we will do all that is necessary to render them fit for publication. Nothing will be too poor for a careful inspection. It will be seen that those contributions which appear in this section show distinct merit, and are both interesting and instructive.

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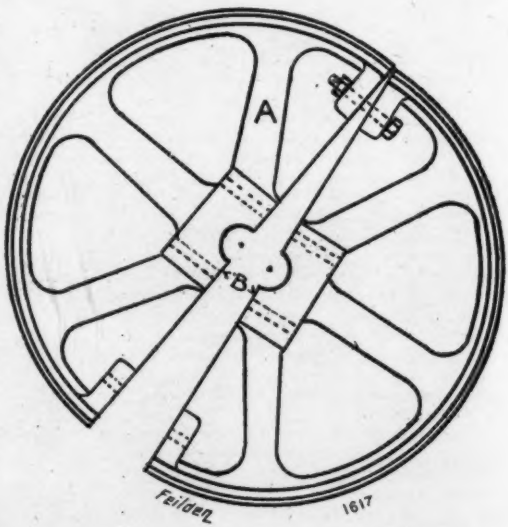
A Millwright's Wrinkle. — The ordinary method of fixing split pulleys on overhead shafts, by first lifting one half, and then pulling up the other until the bolts can be inserted, entails a considerable amount of trouble, together with some risk to the workman, unless every precaution is taken. By adopting the following plan a 3-ft. or 4-ft. cast-iron split pulley can be put in place in a few minutes by a couple of men, without any scaffolding, nothing being required except a pair of blocks suspended from the roof, and a ladder. Take out the bolts, excepting those in one of the lugs on rim; now attach the lifting block to the pulley arm marked *A* on sketch, tighten up until the pulley clears the ground, then slack the nuts in rim lug until the two halves of pulley open out wide enough at *B* to drop on the shaft, hoist to position, and drop on to shaft at the required place. If bolts in rim lug are a tight fit, put in a size smaller until the pulley is in position, and the other bolts tightened up.

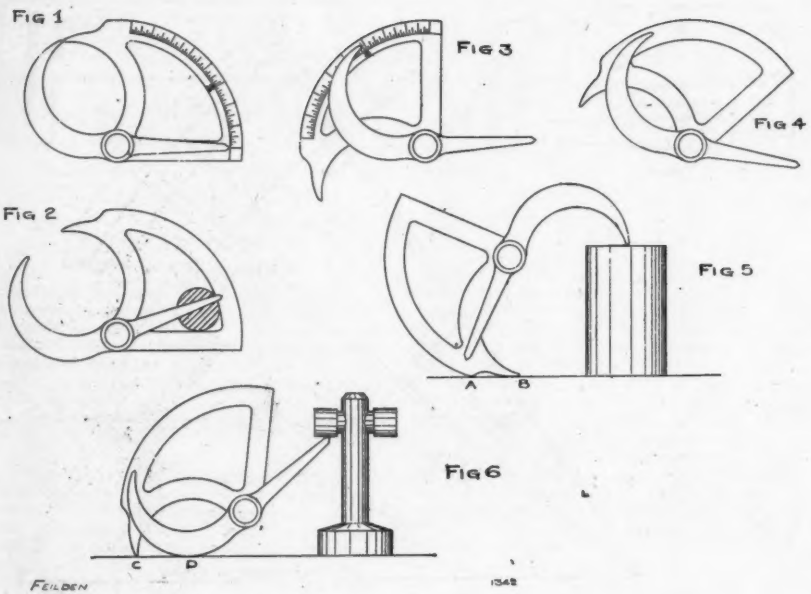
JAMES R. KELLY.



A MILLWRIGHT'S WRINKLE.

Indicating Callipers.—A form of callipers which may be used for a variety of purposes is shown in the accompanying illustrations, and is likely to be of interest to mechanics, as the number of combinations to be got from it constitutes a small kit of tools in itself.

As an indication of the various uses to which it may be put: in Fig. 1 as indicating callipers they are valuable to ascertain the depth of flutes of twist drills, reamers, &c., which have a shank, with centre hole left in for grinding, after hardening. The trouble of taking work from a lathe to gauge the depth of cut is also avoided. In Fig. 2, if correctly made, the distance they are opened out to



INDICATING CALLIPERS.

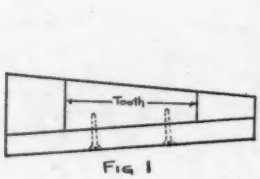
by a round bar will indicate its centre by scribing a line from the outside of indicating finger as in sketch. In Fig. 3, if the edges of the indicating finger and the back of the quadrant are well trued up, they may be set correctly at a right angle by sliding the indicating finger round quadrant to the line marked S as shown. Fig. 4. As an angle or bevel gauge it is useful, and needs no explanation. Figs. 5 and 6 show it used as a height gauge when it may be substituted for an ordinary scribing block for setting up jobs. Fig. 5 shows it used as an outside height gauge, and Fig. 6 as an inside height gauge. It will be found the resting points *AB* and *CD* give a good bearing. The callipers should be made from sheet steel 1·32 in. to 3·64 in. in thickness, and a satisfactory joint can be made by intersecting a washer of brass, of paper thickness, on either side of the joint. This will be found to provide a smooth bearing, and work without jumping or sticking in opening or closing.

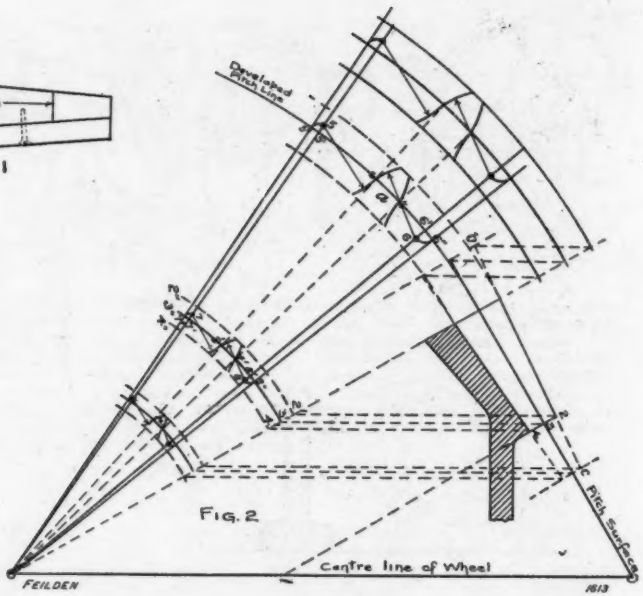
The quadrant scale should be marked from standard plug gauges, and in doing so it will be found that as the callipers are opened wider the space indicated on the scale will be greater for a given measurement than when at zero.

In the illustrations, the scale is only shown on Figs. 1 and 3. It will readily be understood that the accuracy of this scale is a very important point, and care given in this direction will be well repaid.

DENHAM.

Shaping the Teeth of Bevel-Wheel Patterns.—When making a bevel-wheel pattern, the pattern-maker is usually supplied with a full-size development of the larger end of the teeth only, which gives the radii and position of the centres of the curves and the necessary dimensions. Should the teeth be cut in position on the wheel, he has to discover the same particulars for the small end before marking out; or if the teeth are first finished and then fixed to the rim—a common and expeditious way with the larger sizes—a box or mould is used to shape the teeth (Fig. 1), and the pattern-maker has then, before making the box, to determine the shape of its ends, so as to produce the correct size and shape of tooth. Fig. 2 is a section of the rim and tooth of a bevel wheel, and also development of the larger end; produce the small end of the tooth to cut the centre line o, o′ at 1, and draw 2, 2′; 3, 3′; 4, 4′; parallel to o, o′; with centre o draw arcs 2′, 2″; 3′, 3″; 4′, 4″; *a* is the development of the larger end of tooth, and 5 and 6 respectively the centres for bottom and top of tooth. Draw 5, o; 6, o; and with centres 5′, 6′, on the pitch line draw arcs 5, 5″; 6, 6″; and join 5″, 6″ to o: with centres 7′, 8′, draw arcs 7″, 7; 8″, 8; 7 and 8 are centres for bottom and top of tooth respectively at the small end. *s*, *t* is the thickness of tooth at large end, and *s*′, *t*′, found by radiation, the thickness at small end. The small end can now be drawn. To find the shape of the ends of a box add the





SHAPING THE TEETH OF BEVEL-WHEEL PATTERNS.

extra length as at *b* and *c*, and perform the same construction in each case. The construction is shown fully in Fig. 2, for both ends of the box in Fig. 1.

JOHN WATSON.

Fixing Belts on Pulleys at Right Angles.—When driving two shafts at right angles by belting, difficulty is sometimes experienced in setting the pulleys in correct relative positions. The sketch shows the correct method of obtaining the position of top pulley. Drop a plumb line from top shaft to outside of bottom pulley. This gives the centre of top pulley, mark off the width through boss of pulley *A* and fix in position shown. If pulley *B* is required to run in contrary direction, plumb your line to left hand side of pulley *B*. J. R. K.

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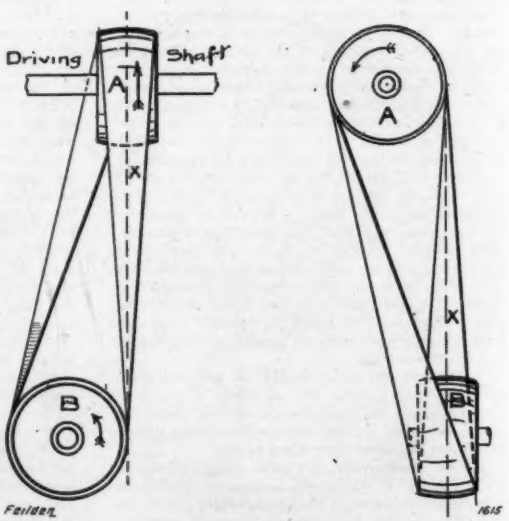

FIXING BELTS ON PULLEYS AT RIGHT ANGLES.

INDUSTRIAL PROGRESS

ENGINEERING NOTES AND COMMERCIAL INFORMATION

FROM ALL SOURCES.

CIVIL ENGINEERING.

Elevated Railway Drawbridge, Boston.—An interesting engineering work is the large drawbridge across the Charles River, Boston, which forms a conspicuous link both in the elevated railway and street-car systems of that city. Its total length is 1,920 ft., of which 1,000 ft. is built across the water. The fixed spans of the approaches, which are of plate girder construction, are 85 ft. in length, while the draw-span has a total length over all of 240 ft. The total width of the bridge is 100 ft., being divided into two 10-ft. sidewalks, two 29-ft. roadways, and a central portion, 22 ft. wide, for the accommodation of the street railways. The draw-span, weighing 1,200 tons, is distinguished by various interesting features. It consists of four parallel trusses, which, it seems, is a unique number, and found in no other bridge. It rotates on a circular track 54 ft. in diameter, and the load is carried upon 70 solid cast-steel wheels, 26 in. diameter each. The machinery for motive power is located in a room beneath the floor of the bridge, in the centre of the turntable. The draw is opened and closed by means of two 28-h.p. railway motors. Moreover, the draw-span is provided with eight hydraulic jacks, four at each end, which are used to lift the ends of the draw when it is closed. The most novel feature of the bridge is the fact that it is double-decked over a portion of its width, the upper deck having the same level as, and forming the continuation of the elevated railway system, which is 18½ ft. above the surface of the roadway. The opening or closing of this bridge requires about 10 mins.

Road Making.—An efficient Road Roller and Scarifier has been one of the exhibits at the Royal Agricultural Society's Show at York this year, having been placed on the market by Messrs. Marshall, Sons & Co., Ltd., Gainsborough. The scarifier is attached to the back end of the tender of the roller, and the weight and strain in connection with it are equally distributed over the full width of the tender. Being mounted on a traversing slide, the scarifier is capable of scarifying up to the gutter on either side of the road without it being necessary to turn the roller round. This is obviously a great advantage when the work is to be done in hilly districts or on narrow roads, and is an improvement not to be met with in other scarifiers. From an illustration and description recently published in *Engineering* it appears that the scarifier can be so arranged that it will operate when the roller is running either backwards or forwards, and the depth of the cut can in each case readily be regulated by means of hand-wheel and worm-gear, which also permits of the scarifier being raised from the ground when not required in work, and this arrangement of gear, moreover, is self-locking in any position. The tools are rigidly held in position by means of wedges, but they can be readily withdrawn when sharpening or replacement is required. The width this machine will scarify in one cut is 12 in. to 15 in., and the depth can be varied from 2 in. to 3 in., depending upon the nature of the road on which it is at work.

MECHANICAL ENGINEERING.

Novel Alarm Gauge for Boilers.—A novel device for indicating the sinking of the water in the boiler below the safe level has been adopted at the engine works of Richard Schwartzkopff, of Berlin. It consists in fitting the gauge cock with two horizontal borings wide enough to prevent clogging, and also with a vertical pipe which widens out at its upper end and is fitted with ribs like a heat radiator. Its upper opening is closed by a pipe screwed into it and sealed by a cone of fusible material. Owing to the steam pressure the apparatus remains filled with water as long as there is sufficient water in the boiler; if, however, the water in the boiler sinks below the normal level, the water in the apparatus will flow through the upper pipe connection and the vertical branch will be filled with superheated steam, which will soon melt the safety plug, which remains solid only at a temperature below 100 or 125 degs. Cent., according to the pressure for which the boiler is constructed. After the melting of the plug the steam will rush out through the nozzles, causing a roar loud enough to attract attention to the condition of things. The attendant, having heard the warning, will, before seeing to the boiler feed, turn a cock in the lower part of the vertical branch to prevent a further escape of steam, and after having attended to the water in the boiler will fit in a new plug and reopen the cock. The apparatus is sufficiently sensitive to function when the water deficiency amounts to ⅓ in.

Pressures for Riveting and Flanging.—A recent issue of the *Journal of the Franklin Institute* contains some notes referring to riveting and flanging pressures, by Mr. H. V. Loss, that may be of interest to many of our readers in consideration of the fact that flanging on cold steel plates by special machines is in great request of late. According to the author, for riveting $\frac{3}{4}$ in. and $\frac{7}{8}$ in. rivets pressures of 60 to 70 tons are required on the rivets, the work done being about 7,200 foot pounds for $\frac{3}{4}$ in. rivets and 9,500 foot pounds for $\frac{7}{8}$ in. rivets. These figures, however, refer to bridge rivets; in boiler work, where rivets are shorter and the holes are usually better finished, less power is needed, and the pressures required are about as follows: For $\frac{3}{4}$ in. rivets, 25 tons; for 1 in. rivets, 66 tons; for $1\frac{1}{8}$ in. rivets, 75 tons; and for $1\frac{1}{4}$ in. rivets, 100 tons. For cold flanging of $\frac{1}{2}$ in. steel plates a pressure of 600 lbs. to 740 lbs. is needed per running inch, whilst with $\frac{5}{8}$ in. plates 710 lbs. to 750 lbs pressure per running inch is required. In hot flanging, however, the pressures used may be much lower, viz., 185 lbs. per running inch for $\frac{1}{2}$ in. plates and 380 lbs. for $\frac{5}{8}$ in. plates, though much will depend upon the heat of the plate at the time the work is done. For cold riveting, pressures of 300,000 lbs. per square inch are needed. Very high pressures are needed for removing waves and wrinkles on a flanged surface, amounting to as much as 1,400 lbs. per square inch of surface.

Machinery, Tools, and General Products for Russia.—H.M. Consul at Taganrog, Sea of Azov, Russia, reports to the Foreign Office that foreign machinery is an article that will be able to hold its own in his district for some time to come, although during the last few years several new machinery works have been erected, to which naturally a portion of the business has been, and will be, diverted. Mining machinery, machinery for metallurgical purposes, pumps, etc., are in special demand, and the same can be said of machine tools, although the bulk of orders for the latter class of manufactures seems of late to have gone to America. Two agricultural machinery factories have been established at Berdiansk and did good business during the last year, some 3,000 hand-rake reaping machines being sold to far-off districts, principally to Saratoff and Voronij, and a few even to Vladivostock *vid* Odessa; many thousands of ploughs were also sold, the demand being a record one. It is stated that the Russian peasant farmers prefer the home-made machine to the American or English self-raking reaper, although at present the prices of the two descriptions are about equal. This, of course, seems incomprehensible when the hard labour required to work the home-made reaper is taken into consideration, and, as the Consul justly remarks, it must be due to the fact that the foreign reaper is not properly pushed and advertised. There can be no doubt that if the advantages of the self-raking reaper were made properly known, there would be an enormous request for them.

Test of a 1,000 h.p. Mill Engine.—An interesting test was recently made by Mr. Geo. H. Barrus on a 1,000 h.p. engine, built by the C. & G. Cooper Company, of Mt. Vernon, Ohio, for the Alabama Mill of the Dwight Manufacturing Company at Alabama City, Ala., U.S.A. The result of the test was remarkable on account of the fact that, with a steam pressure of only 105 lbs., a steam consumption of 12·92 lbs. per h.p. per hour was obtained, this not including the steam used by the condenser, air-pump, or any other auxiliary. The number of expansions were about 15·5. The cylinders of the engine were 28 ins. and $52\frac{1}{16}$ ins. in diameter and 60 ins. stroke. The high and low pressure clearances were 3·5 and 4·8 per cent. respectively. The ratio of their areas was 1 to 3·5. The steam consumption was obtained by metering the feed water and calibrating the meter.

MARINE ENGINEERING.

The London County Council have unanimously decided to apply for Parliamentary powers to institute a steam-boat service on the River Thames. The total cost is set down by the River's Committee at £500,000, of which £300,000 will be for steam-boats at £7,500 each. The annual cost of maintenance will be £140,000. The service will be worked in three sections, the central between London Bridge and Vauxhall, the western between Vauxhall and Hammersmith, and the eastern between London Bridge and Greenwich. The fare is to be 1d. for the central and 2d. fares for each of the other two sections. Mr. A. F. Hills, the chairman of the Steam-boat Company, has given notice that he will oppose the Council's application. The Thames Conservancy is willing that the Council should take over all the piers under their charge, as they are losers to the extent of £5,000 a year.

Admiralty Coal Orders.—The Admiralty has placed a large order for coal with the coal owners of South Wales at a higher rate than they have ever paid before. It is satisfactory to learn that there are immense coal-fields in Australia, and that the price is very low compared with that obtained in this country. New South Wales had an output of 4,600,000 tons last year which brought an average price of 5*s.* 9*d.*; the best quality commands 8*s.* per ton. New Zealand has large coal-fields also, but the output last year was only 1,000,000 tons, while the estimated quantity remaining to be worked is over 1,000,000,000 tons. The difficulty in New Zealand is the want of capital to develop the fields. Much of the coal there is pitch and bituminous coal used for house and ocean-going steamers.

The Laval Steam Turbine is a decided commercial success so far as the consumption of steam per horse-power hour is concerned, but it has not been yet applied to marine purposes.

Probably this is due to the great speed of the turbine—its action depending on the speed of the steam for its power. It does not require any accurate fittings between the nozzle and the blades. The steam is expanded down to atmospheric pressure in the nozzle before it strikes the blades. If the steam enters the nozzle at 75 lbs. it has a velocity of 2,600 ft. per second when it strikes the blades. As early as 1892 a 50-horse turbine was run with an expenditure of 22 lbs. of steam per horse-power. The speed of the turbine varies between 7,500 to 30,000 revolutions per minute depending on the steam velocity. The turbines have been applied to drive high-speed dynamos. The consumption of steam depends on the pressure, and when worked with a condenser the following results have been obtained :—

Pressure of steam in lbs.	85	114	142	170	200
Consumption of steam per i.h.p. per hr.	18·26	17·38	16·50	16·28	16

IRON AND STEEL.

Blast-Furnace Gas.—The following remarks, taken from a lecture by M. Emile Demenge, Ingénieur Métallurgiste to the Société Industrielle de l'Est de la France, may be of interest to our readers :—It has been found possible to work motors with producer gas of relatively slight combustibility provided the ignition be facilitated by a strong compression of the charge, and this fact makes it possible to construct gas motors of great power with an economical yield. A further extension of the same principle is the use of blast-furnace gas, *i.e.*, a gas a little poorer than producer gas, but hitherto regarded of no value, which is gratuitously at the disposal of the owners of iron works. The utilisation of this gas is therefore quite indicated in many cases, and its use in gas-engines makes it possible to abolish the production of steam in boilers heated by gas, so that a costly and often dangerous intermediary ceases to exist, while at the same time a great economy is effected. Many objections have been made to the direct use of blast-furnace gas in engines, the principal criticism being that such gas is very variable, both as regards composition and pressure, and especially as regards the quantity of fine dust held in suspension, and the sometimes corrosive nature of this dust. It was assumed at first that a purification common to all furnaces would not suffice, and sawdust purifiers with coke scrubbers were intercalated in the path of the gas before its introduction into the motors. Experience, however, has shown that all these precautions were unnecessary, so that these cumbersome accessories can be dispensed with. An efficient purification of the gas is always desirable to secure the best effect from the engines, but the manner in which this should be obtained depends on the completeness of the main and preliminary purification. Well purified blast-furnace gas appears by its very nature the most suitable for gas-engines because its chief combustible element is carbonic oxide, the combustion of which yields clean and dry products without the formation of steam, equivalent to a loss in latent heat, such as occurs when gases charged with hydrogen are used. Blast-furnace gas, it is true, contains a great deal of nitrogen, but so does the air, so that excess can be avoided by merely admitting less air to the mixture than when lighting gas is employed.

Wire Demanded for the Argentine Republic.—British wire-makers may be interested in the following report sent by the German Commercial Expert attached to the Consulate at Buenos Ayres to his Government, and republished in *Commercial Intelligence* :—"The estates belonging to cattle breeders cover very large stretches of land. They are all divided off by means of iron wire fences. An estate of 35,000 acres requires about 249 kilometres, or an estate of 180,000 acres, 1,575 kilometres of iron wire, for fencing purposes. These fences, which are about 1½ metres high, are fixed to strong wooden posts sunk into the ground to a depth of from 15 to 20 inches. These posts are joined by six or seven parallel rows of iron wire, so that the cattle cannot possibly escape. Between the main posts intermediary supports or stays are placed at uniform distances. The stays are largely of angle iron, but of late preference has been given to stays of native wood. One row of the wire fencing usually consists of barbed wire. Of late, galvanised or varnished wires have been used, owing to their greater durability. Enormous lengths of iron wire are also required for smaller enclosures within the boundaries of the estate, so that the different breeds and classes of animals can be kept separate. The costs of such a fence are calculated at about 45 paper *centavos* (7 *pesos* = 100 *centavos*) per current metre—posts, stays, and wire included. Over and above this, as Argentine possesses extraordinarily large pasture lands, which will have to be fenced off as cattle breeding develops, the demand for iron wire is bound to increase."

Anomalous Condition of Steel.—A new process, known as the Taylor-White process, discovered at the Bethlehem Works in the United States, is attracting considerable attention. It seems, at first sight, incredible that steel may be treated so that it is harder when it is red-hot than when it is cold ; this, however, has been actually accomplished, and, according to Mr. Porter, it has rendered it possible to speed up machine tools in the Bethlehem shops to four or five times their former capacity. Unless, however, a new kind of machine tool has been constructed, it is not easy to understand how the ordinary tools are rendered powerful enough in driving gear to bear an excess of the normal load so great as that indicated.

RAILWAY AND ROAD TRACTION.

Russian Railway Development.—The *Petersburger Zeitung* publishes a digest of the

Statistical Review of Railway Work in Russia, recently published by the Russian Ministry of Communications, from which we gather the following interesting data. The progress of railway work in Russia during recent years, is perceptible, in the first instance, from the enormous increase in track. In 1892 the total length of Russian and Finnish railways amounted to 30,652 versts, while in the beginning of the present year this length had increased to 51,432 versts, which means that, of the total lines in existence, 40 per cent. were added within the last eight years, while the building of the remaining 60 per cent. required 56 years. Notwithstanding this rapid growth, however, the requirements are by no means as yet satisfied; for, on the one hand, there are extensive districts which still are without railways, and, on the other hand, it will be necessary in certain areas, which moreover are among the most important, to construct competing lines, since those in existence at present are quite insufficient to carry the enormous amount of freight that awaits shipment, which results in considerable injury, especially in the spring and the autumn seasons, to the export trade, the manufacturing industries and to agriculture. The capital invested in railways amounted, in 1897, to 3,958,000,000 rubles, the price per verst being on an average 109,500 rubles, which is a very great expenditure. Of the general cost of construction the Government bears 94·9 per cent., while only 5·1 per cent. are borne by private companies. This is due to the fact that nearly all the private lines have been acquired by the government and, consequently, the amount of unsecured railway stock is exceedingly small. Of special interest are the data regarding passenger traffic. On December 1st, 1894, a new scale of rates was introduced, the lowest in existence in any part of the world, and this resulted in an immense increase of passenger transportation. As regards these, the information here given is taken from another Government publication which deals only with Russia proper, excluding Finland and Siberia. In 1893, according to this publication, the total length of track was 29,226 versts and the receipts for tickets amounted to 49,522,547 rubles; in 1894 the corresponding figures were 31,050 versts and 53,132,710 rubles; in 1895, 32,844 versts and 57,258,093 rubles; in 1896, 33,637 versts and 61,329,627 rubles; in 1897, finally, 35,047 versts and 63,982,396 rubles. From the increase in receipts, however, no conclusion can be drawn as regards profits, since the expenses for the increased traffic may exceed the income. From the document referred to it appears that the gross receipts increased from 1871—1897 four and one-half fold, the gross receipts per verst one and one-half fold. If, however, the amortisation of the invested capital is taken into consideration, we find that while during the first five years of the eighties there was an annual loss of 2,000 rubles for each verst, this loss was reduced in the nineties to 200 rubles per verst, and in 1897 already there was a profit of 600 rubles per verst. This favourable result, however, is not due only to increase of traffic, but also to conversions which secured a cheaper rate of interest for the invested capital, and while there seems to be a loss as regards the capital invested in passenger traffic, freight traffic appears to yield considerable profits. Taking all things together, the interest on the capital invested in Russian railways, as compared with those of other countries, amounted between the years 1895 to 1897 to the following:—

	Per Cent.
European Russia	4·5—4·6
Germany	5·6—6·1
Austria-Hungary	3·9—4·7
France...	3·7—4·0
Great Britain	3·7—3·9
North America	3·1—3·5

Russia, therefore, next to Germany, represents the best investment.

The Best Boiler for Railway Shops.—For a considerable space of time the American Railway Master Mechanics' Association has had under consideration the question as to which type of boilers is the most practical for railway shops, and with reference to this inquiry the *Railroad Gazette* publishes a voluminous contribution, supported by extensive tables and figures, from the pen of Mr. F. W. Dean, who has arrived at the following conclusions: The water-tube boilers have no merit over those with fire tubes, while their cost is nearly double of that of the common tubular horizontal boiler; the latter are superior in nearly every way. The locomotive type of boiler, on account of its economy—and the author carefully proves this economy in stationary service—is the most suitable boiler for railroad shops; in fact, these boilers are the most economical in existence. There is, it is true, a prevailing idea that they are wasteful, but this judgment has been formed from their use in connection with locomotives, where the tremendous rate at which they are worked results in great waste. If any of the locomotive boilers that have been built within the last ten years were worked at such a rate that they would burn 30 lbs. to 60 lbs. of coal per square foot of grate per hour, they would, according to Mr. Dean, give higher evaporation than any stationary water-tube boiler; the trouble is that ordinarily the exhaust is not used to have the coal really burned, but the latter is, so to say, uselessly thrown into the air through the stack. By means of the gentle action of the exhaust a most favourable result might be obtained, and considerable economy would result from the less frequent opening of the fire door when burning the amount of coal mentioned, for gas analysis shows that rapid combustion for stationary engines is better even than slow combustion, and with rapid combustion the various losses are smaller in proportion to the heat generated than with slow combustion, while, at the same time, the combustion tubes are kept cleaner because they are swept clean by the rapid flow of gases.

ELECTRICAL ENGINEERING.

Electro-mobile Progress.—To judge from American experience, the electro-mobile appears

to be growing in favour from day to day, and to be considered the ideal self-propelled vehicle for city service and for limited distances. This is not astonishing when it is known that quite recently one of the Electric Vehicle Company's carriages was run on one charge of the accumulator from Boston to Newport, over roads which made the distance 72½ miles. The total time consumed, including stops, was 5 hrs. and 18 m., and the average speed was over 14 miles per hour. To this must be added the fact that the vehicle referred to was not designed for speed, and no special effort was made to obtain it. This run, however, taken in connection with similar results obtained of late by electric vehicles, seems to justify the claim of the electro-mobile for special consideration, especially when its simplicity and convenience are taken into consideration. There is little doubt that ere long electro-mobiles will be constructed to make a run up to 100 miles on a single charge of the battery, in which case they would certainly occupy the first place in the favour of the public for urban and suburban traffic and for communication between neighbouring towns.

Electric Traction in Germany.—An experimental train has recently made successfully the journey from Berlin to Zehlendorf on the new Wannsee Railway. The train was arranged exactly as it will be when it is running in future on schedule time, *i.e.*, it ran on 30 axles, having a total weight of 220 tons. There was a motor car in front and in the rear, each doing an equal portion of the work. In this way the reversal of the train for the return journey becomes unnecessary. The mains from which the current is derived are protected by wooden casings. The front portion of the motor car contains all the necessary apparatus for working the train and room for the driver, while the rear portion serves for baggage, etc. There are eight ordinary cars between the two motor cars, granting accommodation to about 400 passengers. The brakes are air-brakes, and the signalling whistles are also worked by compressed air. All the cars are lighted by incandescent lamps. Exteriorly the train does not differ from any ordinary railway train, except in so far as the steam locomotive is absent. The railway authorities intend, as soon as the trial trips are over, to have the electrical train make several journeys each day, and to experiment with it under the most diversified conditions for the full length of one year. After that period it is believed sufficient experience will have accumulated to show whether it will be expedient to abolish steam power entirely, and to equip all the trains with electric motors. The line Berlin-Zehlendorf has a length of 12 miles, and the train is to cover this distance, including stoppages, in 27 mins. The experimental trips during the stipulated period of twelve months will give an opportunity for important measurements and the collection of accurate data. So much, however, has already been demonstrated, namely, that electric motive power is about 15 per cent. cheaper than steam, and that even with increased speed there is considerably less danger of accidents.

Wireless Telegraphy.—Some time ago a pole 115 ft. high was erected at Ilfracombe and a similar one at the Mumbles preparatory to some experiments in wireless telegraphy across the Bristol Channel, a distance of about 25 miles. The system to be investigated is that designed by Sir W. H. Preece before Marconi, and recently improved by him. The Navy has, for the time being, abandoned the system of the Italian inventor, and resumed the trials of Captain Jackson's method, which also is of older date than that of Marconi. During former experiments Captain Jackson's system has not been tried for distances beyond 25 miles, and was found to be somewhat imperfect, in so far as the dots and dashes were not clearly separated. How far this defect has been remedied is not yet known. There is no doubt that our naval authorities are fully alive to the importance of wireless telegraphy, since experiments have been carried on, with greater or lesser success, on 32 vessels of the Navy, at a cost of £6,400, to which must be added about £3,000 charged by the company holding the royalty.

MINING.

Cape Nome Gold Mining.—The accounts from the Nome District in Alaska are even more unsatisfactory than was anticipated by the least sanguine persons in Europe. The mining region is so overcrowded that the military commander, who is now in control, has forbidden newcomers to land at Nome City, and has ordered the establishment of some new settlement some miles distant. There are no facilities as yet for handling freight, and great quantities of supplies and machinery are piled up on the beach. It is almost impossible for owners to get their property to the place where it is required. To this must be added the great uncertainty of titles, since almost all accessible claims have been located by two or three different persons, so that new arrivals desiring to buy claims are confronted by several alleged owners. The result will most probably be endless litigation. As regards the gold production, it is estimated that the Nome district will yield from $4,500,000 to $5,000,000 during the present year. Prospectors are scattered along the seashore for 50 miles, the great rush having, of course, been for the beach placers, which can be reached and tested without the labour required for exploring the tundra back of the coast. There are signs that the great rush is over, and the number of newcomers is decreasing, for the transportation companies are reducing their fares and offering special inducements. If this decrease of arrivals should continue, there is hope that some serious mining will become possible next year.

Miners' Wages.—The quarterly meeting of the Conciliation Board in the Northumberland coal trade, to deal with questions referring to wages, was recently held at Newcastle-on-Tyne. It was stated on that occasion that the average selling price of coal in the county during the second quarter of the year had been 10*s.* 1½*d.* per ton, an increase of 1*s.* 2½*d.* per ton over the price of the previous quarter, the prices having reached almost the highest figure ever obtained in the history of the Northumberland coal trade. Mr. Thomas Burt, M.P., on behalf of the miners, asked for an advance of 15 per cent. in the wages. The employers declared themselves ready to grant a substantial advance, but thought that 8¾ per cent. would be an adequate figure. The miners then reduced their demand to 12½ per cent., whereupon the owners offered 10 per cent. Finally, however, the chairman awarded the miners the 12½ per cent. asked for. This advance, added to the 10 per cent. increase granted in April, increases the miners' wages 52½ per cent. above the standard of 1879.

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In this section is presented every month a concise précis of the contents of the leading organs of the technical press and of the proceedings of the learned societies throughout Great Britain, the Continent, and America, and also, in a summarised form, the subject matter of the more important articles appearing therein.

This systematic record should prove of the greatest value to those of our readers interested in one or more specific sections of technology, trade or economics, or to those who have insufficient leisure to peruse the large number of publications now appearing.

The following is an Index to the abbreviations used throughout the section. It gives an alphabetically-arranged list of the publications regularly reviewed, together with the place of publication. In most cases where publications are not readily procurable, with the exception of Transactions of the learned societies, copies of the articles can be supplied on application and by remitting 7d.

Am. Engr. ...	American Engineer	New York
Am. Machy. ...	American Machinery	New York
Am. Mach. ...	American Machinist	New York
Am. Mftr. and Ir. Wld.	American Manufacturer & Iron World	Pittsburg
Am. Shipbldr.	American Shipbuilder	New York
Ann. des Pts. et Chauss.	Annales des Ponts et Chaussées	Paris
Archt.	Architect	London
Arch. Rcd. ...	Architectural Record	New York
Arch. Rev. ...	Architectural Review	Boston U.S A.
Arms and Exp.	Arms & Explosives...	London
Aust. Min. Stand.	Australian Mining Standard	Sydney
Autom. and Horsel. Veh. Journ.	Automotor and Horseless Vehicle Journal	London
Berg Hüttenm. Ztg.	Berg und Hüttenmannische Zeitung	Berlin
Board of Tr. Journ.	Board of Trade Journal	London
Brit. Archt. ..	British Architect ...	London
Bri. and Col. Prtr.	British & Colonial Printer	London
Bldr.	Builder...	London
Bldrs'. Journ.	Builders' Journal ...	London
Bull. d. l. Soc. d'Encour.	Bulletin de la Société d'Encouragement	Paris
Canad. Archt....	Canadian Architect	Toronto
Canad. Elec. News	Canadian Electrical News	Toronto
Canad. Engr. ...	Canadian Engineer	Montreal
Can. Mftr. ...	Canadian Manufacturer	Toronto
Canad. Min. Rev.	Canadian Mining Review	Ottawa
Carr. Bldrs'. Journ.	Carriage Builders' Journal	London
Chamb. of Com. Journ.	Chamber of Commerce Journal	London
Chem. Trds. Journ.	Chemical Trades Journal	Manchester
Coach Bldrs'. Art Journ.	Coach Builders' Art Journal	London
Cold Storage ...	Cold Storage ...	London
Coll. Guard. ...	Colliery Guardian ...	London
Comm. Int. ...	Commerce Intelligence	London
Compt. Rend. ..	Comptes Rendus de l'Acad. des Sciences	Paris
Compt. Rend. des Ing. Civ.	Compte Rendu de la Société des Ingénieurs Civils	Paris
Contr. Journ. ...	Contract Journal ...	London
Deutsch. Techn. Ztg.	Deutsche Techniker Zeitung	Berlin
Dingler's Polyt. Journ.	Dingler's Polytechnisches Journal	Stuttgart
Dipl. and Cons. Rpts.	Diplomatic & Consular Reports	London & Washington
Ech. d. Mines	Echo des Mines ...	Paris & Brussels
Ecl. Elect. ...	Eclairage Electrique	Paris
Elec. Engr. ...	Electrical Engineer	London
Elec. Engrg. ..	Electrical Engineering	Chicago
Elec. Rev., London	Electrical Review ...	London
Elec. Rev., New York	Electrical Review ...	New York
Elec. Wld. ...	Electrical World ..	New York
Electn.	Electrician	London
Electn., Paris ...	Electricien	Paris
Electrotechniker	Elektrotechniker	Vienna
Electy., London	Electricity	London
Electy., New York	Electricity	New York
Elektrochem. Ztschrft.	Elektrochemische Zeitschrift	Berlin
Elektrotech. Ztschrft.	Elektrotechnische Zeitschrift	Berlin
Elettricita ...	Elettricita	Milan
Engr.	Engineer	London
Engr., Cleveland	Engineer	Cleveland, U.S.A.
Engrg.	Engineering ...	London
Engrg. and Min. Jour.	Engineering and Mining Journal	New York
Engrg. Mag. ...	Engineering Magazine	New York & London
Engrg. News ...	Engineering News ..	New York
Engrg. Rcd. ...	Engineering Record	New York
Engl. Mech. ...	English Mechanic ...	London & New York
Gas Wld. ...	Gas World	London
Gaz	Gaz, Le...	Paris
Gén. Civ. ...	Génie Civil	Paris
Ges. Ing. ..	Gesundheits-Ingenieur	Munich
Glaser's Ann. ..	Glaser's Ann. f. Gewerbe und Bauwesen	Berlin
Hrdw., Mets. and Machy.	Hardware, Metals & Machinery	London
Hrdw. Trds. Journ.	Hardware Trades Journal	London
Heatng. and Ventng.	Heating & Ventilating	New York
Hosiery Tr. Jr.	Hosiery Trade Journal	Leicester

Ice and Cld. Storge.	Ice & Cold Storage	London
Ill. Off. Journ. of Pat.	Illustrated Official Journal of Patents	London
Ind. and East. Engr.	Indian & Eastern Engineer	Calcutta
Ind. Engrg.	Indian Engineering	Calcutta
Ind. Elec. Chim.	Industrie Electro Chimique	Paris
Ingrm.	Ingenorum	Copenhagen
	Irish Textile Journal	Belfast
Ir. Age.... ...	Iron Age	New York
Ir. and Coal Trds. Review	Iron and Coal Trades Review	London
Ir. and Steel Trds. Journ.	Iron & Steel Trades Journal	London
Irnmgr. ...	Ironmonger	London
Jr. Ass. Eng. Socs.	Journal of the Association of Engineering Societies	Philadelphia
Jrn. Chem. Soc.	Journal of the Chemical Society	London
Journ. of Comm.	Journal of Commerce	Melbourne
Journ. of Elec.	Journal of Electricity	San Francisco
Journ. of Electr. Power and Gas	Journal of Electricity Power and Gas	San Francisco
Journ. of Gas Lghtng.	Journal of Gas Lighting	London
	Journal Inst. Elec. Engrs.	
Journ. of Roy. Inst. of Br. Archts.	Journal of Royal Inst. of British Architects	London
Journ. of State Med.	Journal of State Medicine	London
Journ. of Soc. of Arts	Journal of the Society of Arts	London
Knowl.	Knowledge	London
Ldry. Journ. ...	Laundry Journal ...	London
Ldry. Rec. ...	Laundry Record ...	London
Lghtng.... ...	Lightning	London
Lt. Ry. & Tramw. Jr.	Light Railway and Tramway Journal	London
Locom. Engrg.	Locomotive Engineering	New York
Loc. Mag. ...	Locomotive Magazine	London
Machinery, London	Machinery	London
Machinery, New York.	Machinery	New York
Mach. Mark. ...	Machinery Market ...	London
Mfrr.	Manufacturer	Philadelphia
Mar. Engr. ...	Marine Engineer ...	London
Mar. Engrg. ...	Marine Engineering	New York
Mech. Engr. ...	Mechanical Engineer	Manchester
Mech. Prog. ...	Mechanical Progress	M'chr
Mech. Wrld. ...	Mechanical World ...	London
Metall.	Metallurgie	Paris
Miller	Miller	London
Mns. & Mnrls.	Mines and Minerals	Denver
Min. Journ. ...	Mining Journal ...	London
Ming. Wld. ...	Mining World ...	London
Mitt. a. d. Kgl. Tech. Versuchsanst, Berlin	Mitt. aus d. Kgl. Tech. Versuchsanst	Berlin
Mod. Machy. ...	Modern Machinery...	Chicago
Mois Scient. ...	Mois Scientifique ...	Paris
Motor Cr. Jr....	Motor Car Journal...	London
Nat. Ldry. Journ.	National Laundry... Journal	Chicago
Nature	Nature	London
Nature, Paris ...	Nature	Paris
Naut. Gas. ...	Nautical Gazette ...	New York
N. B. Agrilt. ...	North British Agriculturist	Edinburgh
Oest. Monatsschr. f. d. Oeff. Baudienst	Oest. Monatsschr. f. d. Oeff. Baudienst	Vienna
Oest. Zeitschr. f. Berg u. Hüttenwesen	Oest. Zeitschr. f. Berg und Hüttenwesen	Vienna
Power	Power	New York
Pract. Engr. ...	Practical Engineer...	London
Proced. Am. Soc. Civ. Engrs.	Proceedings, Am. Soc. of Civil Engineers	New York
Proced. Engrs. Club	Proceedings of the Engineers' Club of Philadelphia	Philadelphia
Pub. Hlth. Engr.	Public Health Engineer	London
Rld. Gaz. ...	Railroad Gazette ...	New York
Ry. Age ...	Railway Age	Chicago
Rail. Engr. ...	Railway Engineer ...	London
Rail. and Engng. Rev.	Railway & Engineering Review	Chicago
Rail. Mag. ...	Railway Magazine ...	London
Railw. Mast. Mech.	Railway Master Mechanic	Chicago
Rail. News ...	Railway News ...	London
Rail. Rcd. ...	Railway Record ...	London
Ry. Sup. Jr. ...	Railway Supplies Journal	London
Rev. Min. ...	Revista Minera ...	Madrid
Rev. Tech. ...	Revue Technique ...	Paris
Rev. d. Chim. Ind. ...	Revue de Chimie Industrielle	Paris
Sch. Mines Qtly.	School of Mines Quarterly	New York
Science Abstr....	Science Abstracts ...	London & New York
Sci. Am. ...	Scientific American	New York
Sci. Am. Suppl.	Scientific American Supplement	New York
Shpng. Wrld.	Shipping World ...	London
South Afr. ...	South Africa... ...	London
Stahl u. Eisen..	Stahl und Eisen ...	Dusseldorf
Steamsh. ...	Steamship	Leith
Stevens' Inst. Ind.	Stevens' Institute Indicator	New York
Stone	Stone	New York
St. Ry. Inter. Jr.	Street Railway International Journal	New York
Survr.	Surveyor	London
Syr.	Syren	London
Tech. Qtly. ...	Technology Quarterly	Boston
Text. Ind. ...	Textile Industries ..	Bradford
Text. Merc. ...	Textile Mercury ...	Manchester
Text. Rcdr. ...	Textile Recorder ...	Manchester
Text. Ztg. ...	Textil-Zeitung ..	Berlin
Tramw. and Railw. Wld.	Tramway & Railway World	London
Trs. Am. Soc. M. E.	Transactions of the American Society of Mechanical Engineers	Cincinatti
Trs. Inst. Nav. Arch.	Transactions of the Inst. of Naval Architects	London
	Trans. Inst. Engrs. & Shipbuilders	Glasgow
Trs. N. E. Inst. Engrs. and Shpbldrs.	Transactions of the N. E. Coast Institution of Engineers and Shipbuilding	Newcastle
	Trans. Soc. Engrs.	
Un. Ser. Mag.	United Service Magazine	London
West. Electn. ...	Western Electrician	Chicago
Ztschrft. d. Oest. Ing. u. Arch. Ver.	Zeitschr. d. Oest. Ing. u. Arch. Vdr.	Vienna
Ztschrft. d. Ver. Deutsch. Ing.	Zeitschr. d. Ver. Deutscher Ingen.	Berlin
Ztschrft. f. Elektrochem.	Zeitschrift für Elektrochemie	Halle a. S.
Ztschrft. Elektrotech.	Zeitschrift für Elektrotechnik	Halle a. S.

ARCHITECTURE AND BUILDING.

1. Construction and Design.

Banking Premises.—*New Banking Premises in Fleet Street.* Description of the new premises of Messrs. Barclay & Co., distinguished by the very skilful utilisation of a rather restricted area and a very lavish and elegant display of beautiful architectural design. (Ill.) 2½ cols.—*Bldrs.' Journ.*, July 11th, 1900.

Concrete Foundations.—*Mr. Beaumont Hill Jones' Patent System of Constructing Concrete Foundations.* Description of a system by which the inventor claims to be able to dispense with the expensive dam usually required for constructions in deep water. 2 cols.—*Ry. Supplies' Journ.*, June 7th, 1900.

Exhibition Buildings.—*The Pavilions on the Banks of the Seine.* The article deals with the very picturesque and interesting group of buildings temporarily ornamenting the bank of the Seine in the Rue des Nations, which show an extraordinary variety of style and design, and which, as the author points out, are quite unique in their striking effect. 5 cols.—*Bldr.*, July 7th, 1900.

—— *The Municipal Pavilion at the Paris Exhibition.* Description of the Pavilion illustrating the work of the "Ville de Paris" at the present Exhibition which is a much more important affair than that of the 1889 Exhibition, and is of very dignified appearance, containing appropriately some of the architectural proportions of the Hôtel de Ville. 3¼ cols.—*Bldr.*, July 7th, 1900.

—— *The Exhibition of 1900. The Pavilion of Messrs. Schneider & Co.* The article deals with the construction of the metallic cupola of the building containing some of the finest specimens of this famous engineering firm, notably guns and war material. (Ill.) 6½ cols.—*Génie Civil*, June 30th, 1900.

—— *The Exhibition of 1900. The Palace of Horticulture.* Description of the edifices sheltering the exhibits of agriculture and arboriculture, being two magnificent hot-houses situated on the bank of the Seine, in the Cours de la Reine, exclusively devoted to French exhibits. (Ill.) 2¾ cols.—*Génie Civil*, June 23rd, 1900.

Expanded Metal.—*Expanded Metal.* The author, after referring to the extraordinary success which has crowned the invention of Mr. J. French Golding, describes the mode of manufacture and the various stages which the metal sheet has to pass before it reappears cut into trellis work. (Ill.) 7½ cols. (to be continued).—*Revue Techn.*, July 10th, 1900.

Hospital Buildings.—*The Bedford County Hospital.* Concise description accompanying a number of illustrations showing the appearance of the Bedford County Hospital completed in June of last year, and designed by H. Percy Adams, F.R.I.B.A., architect. The entire cost was £34,000, *i.e.*, about £370 per bed, a very moderate price, considering accommodation provided. ¾ col.—*Brit. Archt.*, July 13th, 1900.

House Building.—*Some Designs for Houses.* The article accompanies a number of very picturesque designs by Mr. James Ransome, distinguished by that architect's original four-square wall treatment. ½ col.—*Brit. Archtct.*, July 6th, 1900.

2. Heating and Ventilation.

Heating and Ventilation.—*Modern Practice in Steam Heating and Ventilation.* By Wm. S. Monroe. The present instalment deals with mechanical ventilation and its general principles. The author points out that no system of ventilation is adequate to give proper results in all cases and in all kinds of weather unless it is a mechanical system, and discusses the various points of importance and principles connected with an efficient method. 4 cols.—*Engrg. Rcd.*, June 30th, 1900.

Hot Water Heating.—*Low-Pressure Hot Water Heating.* By Mr. J. Nelson Russel. The author is of the opinion that the popularity of low-pressure heating is unquestionable, and will hold its position for years to come in spite of the advancement in the methods of heating by steam or other agents, because it is easily attended to and economical. The paper, with summary of the discussion following, occupies 7½ cols.—*Ironmonger*, July 14th, 1900.

Hot Water Supply. — *Domestic Hot Water Supply.* By Mr. Dye. Abstract of a paper read at the summer meeting of the Institution of Heating and Ventilating Engineers, July 10th, in London. The author remarks that it is usually considered that with a hot water apparatus for domestic purposes it is sufficient if the boiler is capable, the hot water reservoir (cylinder or tank) of proper size, and the piping arranged to secure a free and efficient circulation; there is, however, a fourth detail that requires consideration, and that has been much neglected in the past, namely, the connection of the branches so that the taps yield the hottest water only, and all there is of it; he then proceeds to describe the best method for obtaining this result. (Ill.) 7 cols.—*Ironmonger*, July 14th, 1900.

3. Plumbing and Gasfitting.

4. Miscellaneous.

Architecture.—*The Education of the Public in Architecture.* A paper by Mr. Reginald Blomfield, read before the Royal Institute of British Architects during the General Architectural Congress, in which the author points out that there is a very real necessity of educating the public in architecture, and that the general level of taste and ability, to judge from the architecture of our great cities, is very low. Among other means for educating the public the author recommends the drawing up of plain pattern books for builders by a committee of architects. 5½ cols.—*Bldr.*, June 30th, 1900.

Modern Architecture.—*German Architecture.* Under this title the paper quoted below publishes a criticism of modern architecture in Germany, maintaining that it indicates some form of mental disease, since the designs are weird, fantastic, and incongruous, in support of which the author refers to a recent number of the *Berliner Architekturwelt.* 1½ col.—*Bldrs.' Journ.*, July 11th, 1900.

CIVIL ENGINEERING.

1. Bridges.

Bridge Construction.—*Use of Old Rails in Overhead Bridges, N.S.W. Govt. Rys.* The article describes the method and the details of using rails, too badly worn for service, for the construction of trusses for overhead bridges in New South Wales. (Ill.) 1¾ col.—*Ry. and Engrg. Rev.*, July 7th, 1900.

Bridges.—*The Siberian Railway.* The article deals with the building of the bridge across the Yenissei. During the progress of the railway it occurred to the engineer, Von Knorre, to make use for bridge-building of the wood locally found, instead of using the more costly iron, for the caissons of bridge pillars. Attempts had already been made in America to construct wooden caissons, but the results were not satisfactory; those, however, built by Mr. Von Knorre answered their purposes in every respect, and the advantages were especially shown in constructing the bridge across the Yenissei, with which the present article deals. 1½ col.—*Engr.*, July 6th, 1900.

—— *The L'Oued Endja Bridge, Algeria.* Description of an Algerian bridge on the route from Constantine to Djidjelli viâ Mila, showing some interesting peculiarities in its construction, pointed out in a note by M. A. Daujon, civil engineer, which forms the basis of the article. (Ill.) 3½ cols.—*Génie Civil*, June 16th, 1900.

—— *New Double 140 ft. Span Stone Arch Bridge for the Fitchburg R.R. at Bellows Falls, Vt.* Description of a very notable stone arch railway bridge in Vermont, U.S.A., recently completed by the Fitchburg R.R. to carry its line across the Connecticut River at Bellows Falls. (Ill.) 1½ col.—*Engrg. News*, June 21st, 1900.

—— *The Exhibit of Typical American Bridges at the Paris Exhibition.* Description of a series of drawings, ten in number, illustrating American bridges, forming a part of a collection of drawings executed by the

author for the United States Commission; these drawings are too few to illustrate the development of bridge construction in the United States, but are an interesting exhibit of typical designs. 5½ cols.—*Engrg. News*, July 5th, 1900.

Foot-Bridge.—*A Cantilever-Arch Bridge at the Paris Exhibition.* Description of a temporary bridge erected between the Pont de l'Alma and Pont d'Jéna, having a length of 394 ft., and being peculiar in appearance as well as possessing unusual features of design and construction. (Ill.) 2 cols.—*Engrg. Rcd.*, July 14th, 1900.

2. Canals, Rivers, and Harbours.

Canals.—*The Topography of the Nicaragua Canal Route, and the Plans and Estimated Cost of Constructing the Canal.* By E. S. Wheeler, M.Am.Soc.C.E. The author, who is the chief engineer of the Nicaragua Canal Commission, summarises the report of the Commission of 1897-9, which contains 500 pp. text and a volume of 40 maps, and gives the principal results in a few pages without data or discussion. (Ill.) 9½ cols.—*Engrg. News*, July 12th, 1900.

Dredgers.—*Hydraulic Dredger for Calcutta.* Description of a hydraulic dredger which has lately been completed at the Walker shipyard of Sir W. G. Armstrong, Whitworth & Co., Ltd., from designs by Mr. Lindon W. Bates. (Ill.) 1½ col.—*Engr.*, June 29th, 1900.

Dredges.—*Dredges on the Mississippi.* Description of the interesting dredges of which during the greater part of the year there are at work in the Mississippi, in charge of the Mississippi River Commission, at least six, most of which have cost over 100,000 dols., and are capable of dredging from 700 to 1,000 ft. of sand per hour from a depth of 15 ft. (Ill.) 1½ col.—*Sci. Am.*, July 7th, 1900.

Ship Canal.—*Methods and Results of Surveys and Borings for Oswego-Mohawk Ship Canal Route.* By D. J. Howell. Description of a ship canal route extending from the Hudson River near Troy, N.Y., *viâ* the Mohawk Valley and Oneida Lake, to Lake Ontario, being one of the routes authorised to be investigated by the U.S. Board of Engineers on Deep Waterways, created under Act of Congress of 1897. (Ill.) 6 cols. and 11 cols. respectively.—*Engrg. News*, June 21st and June 28th, 1900.

3. Irrigation.

4. Miscellaneous.

Road Building.—*A California Cycleway.* By Charles Frederic Holder. Description of one of the most interesting novel constructions to be seen at present in Southern California, viz., a smooth and strong cycle-road between Los Angelos and Pasadena, nearing completion and already partially opened to the public, for bicycles and motor-cycles, nine miles in length, the inventor and promoter of which is a wealthy resident of Pasadena, Mr. Horace Dobbins. 1¾ col.—*Sci. Am.*, July 14th, 1900.

Road Making.—*Road Making and Road Metal.* The article deals with the most appropriate methods of road-making, and the author describes the characteristics of the most important modern systems, notably those of Telford and MacAdam, attributing to the former a greater grasp of subject and a far higher order of engineering skill than to MacAdam. 2¼ cols.—*Autom. Journ.*, July 14th, 1900.

Viaducts.—*Riverside Drive Viaduct, New York.* Description of a handsome viaduct in course of construction, bridging Manhattan Valley, for the purpose of connecting Riverside Drive with the important system of driveways which encircles the northern end of Manhattan Island. (Ill.) 1¼ col.—*Sci. Am.*, July 21st, 1900.

ELECTRICAL ENGINEERING.

1. Electro-Chemistry.

Electro-Chemistry.—*Advancement of Electrical Chemistry.* By F. Mollwo Perkin. The author reviews the enormous progress of electro-chemistry from the time, 100 years ago, that Carlisle and Nicholson first showed that water can be decomposed into its constituents by a volta pile. 5½ cols.—*Elec. Rev.*, July 4th, 1900.

Electrolysis.—*Electrolysis of Underground Metal Structures.* By Dabny H. Maury. Slightly condensed reproduction of a paper read by the author before the American Waterworks Association at Richmond, Va., May, 1900. (Ill.), 8½ cols.—*Engrg. News*, July 19th, 1900.

—— *Electrolysis of Alkali-Chloride Solution in Industrial Practice.* By Prof. Dr. C. Häussermann, Stuttgart. The author gives a full description of various methods of decomposing alkali-metal compounds on a commercial scale, which nearly all have been made known within the last ten years. (Ill.) 12 cols.—*Dingler's Polyt. Journ.*, July 28th, 1900.

Electrolytic Products.—*Electrolytic Production of Induline Dye-stuffs.* Digest of a contribution to the *Zeitschrift für Electrochemie*, by E. C. Szarvasy, in which he describes a process for obtaining from a molten mixture of aniline and aniline-hydrochloride certain induline dye-stuffs, the cell used consisting of a graphite crucible, which is the anode, and contains the molten mixture; the cathode being a similar vessel, only smaller, so arranged that it is kept in continuous rotation within the larger one, *i.e.*, the anode. ¾ col.—*Electro-Chem. Rev.*, June, 1900.

Electro-Metallurgy.—*Hydro-Electric Works at La Praz, Savoy.* Description of one of the four important electrolytic works of the "French Electro-Metallurgical Society," which is situated at La Praz, and, like the three others, is used for the production of aluminium, The article describes in detail the equipment of the power station at the place mentioned, and the hydraulic installation. (Ill.) 2½ cols.—*Génie Civil*, June 28th, 1900.

2. Electric Lighting.

Electric Lighting.—*Alternating-current Street-Lighting Plant at Downer's Grove.* Description of the street-lighting plant at Downer's Grove, Ill., U.S.A., a small town of from 3,000 to 3,500 inhabitants, which is interesting as a model for municipal enterprise of a similar kind elsewhere. (Ill.) 2½ cols.—*West. Elect'n.*, June 30th, 1900.

—— *Electric Lighting of Doxford Hall, Northumberland.* Description of a plant in a private residence consisting of two 12½ B.H.P. Hornsby-Akroyd oil engines, each driving a Crompton shunt-wound dynamo by belt and two sets of accumulators. There are 300 incandescent lamps distributed throughout the house and outbuildings, while there is also a search-light and numerous power applications. (Ill.) 1 col.—*Elec. Rev.*, July 6th, 1900.

—— *The Lighting of Small Towns.* By G. M. Harris, Electrical Engineer, Bray, Ireland. Abstract of a paper, read before the Municipal Electrical Association, in which the author points out that the chief difficulty is to make such an undertaking pay, and that therefore it will receive but little attention from private companies, and be left to local authorities. 3½ cols. *Electricity* (*N.Y.*), July 11th, 1900.

—— *An Automatic Electric Car-Lighting System.* Description of the Gould car-lighting system, recently introduced into the United States, after having been in use in Great Britain for some years, though in a less perfect form. (Ill.) 2½ cols.—*Elec. Rev.*, July 4th, 1900.

—— *Arc Lighting.* Editorial reviews of the history of arc lighting since its first commercial application during the Centennial Exhibition of 1876 up to the most recent times; pointing out the gradual improvements, such as the enclosed arc lamp, which can be burned from ordinary low-tension constant-voltage sources of supply, the discovery that series lamps could be burned upon alternating circuits, etc. 3 cols.—*Elec. Rev.* (New York), June 20th, 1900.

3. Power.

Central Stations.—*The Arrangement of Central Station Piping.* By William D. Ennes. The author points out the necessity of special training in order to

properly design the steam and water piping of a power-plank, and gives practical hints for the arrangement of piping in central stations. The article is reproduced from the *American Electrician*. 3¾ cols.—*Mech. Wrld.*, July 13th, 1900.

Dynamos.—*The A. E. G. 3,000-Kilo-watt alternator at the Paris Exhibition.* Description of a large three-phase alternator which the Allgemeine Elektricitäts Gesellschaft are exhibiting in the German section of the Paris Exhibition, and which gives 3,000 kilo-watts when running at 83 revolutions. (Ill.) ¼ col.—*Elec. Rev.*, July 13th, 1900.

Electrical Supply.—*The Distribution of Electricity to Scattered Areas.* Abstract of a paper by Mr. L. Andrews, Borough Electrical Engineer, Hastings, in which the author discusses the respective merits of the continuous-current system and that of high-tension alternating currents. 4½ cols.—*Elec. Engr.*, July 13th, 1900.

—— *Distribution of Electricity.* By G. Wilkinson, Borough Electrical Engineer, Harrogate. Abstract of a paper read before the Municipal Electrical Association at the Huddersfield Convention, in which the author endeavours to make clear certain practical difficulties which have hitherto been somewhat neglected in favour of more interesting, but perhaps less important, engineering details. 4½ cols.—*Elec. Engr.*, July 13th, 1900.

Electric Generator.—*A 3,000-Kilo-watt German Polyphase Generator. Description of a very large alternating Generator*, exhibited at the Paris Exhibition by the Allgemeine Elektricitäts Gesellschaft of Berlin, being one of eight generators of the same size, *i.e.*, furnishing 3,000 kilo-watt, just finished or now building at the company's works, and destined for the new Oberspree and Moabit outlying stations of the Berlin Electrical Works. (Ill.) 1 col.—*West. Elect'n.*, June 16th, 1900.

—— *The Paris Exhibition.* This instalment is devoted to a description of a dynamo constructed by Mather and Platt, Manchester, coupled to an engine made by Messrs. Galloway, and to the exhibit of Messrs. Kolben & Co., of Prague, consisting of an alternator of 8,000 volts. (Ill.) 3½ cols.—*Elec. Rev.*, July 27th, 1900.

Electric Plant.—*The Blackheath and Greenwich Electric Light Company's Station.* Description of a plant inaugurated in virtue of a provisional order empowering the company to supply electricity in Greenwich and Blackheath in the year 1897, although active work began only in 1898. (Ill.) 1¾ col. (To be continued.)—*Engr.*, July 20th, 1900.

—— *The Electric Lighting and Tramways of Buenos Ayres.* (Continuation.) Description of the generators, the switch-board, the cables, the equipment of the boiler-house, etc. 2½ cols. *Elec. Rev.*, July 20th, 1900.

—— *Gloucester Corporation Electricity Works.* Description of the municipal electric supply works of Gloucester, which were opened on July 19th this year, and appear to possess every desirable feature; centrally located with regard to the lead, they offer ample room for extensions, and have already a good start, beginning with work equivalent to 14,000 lamps. (Ill.) 4½ cols.—*Lightning*, July 26th, 1900.

Electric Power Plant.—*Electric Power in Cripple Creek District.* By J. W. Dickerson. Description of an interesting plant supplying power to a great number of producing mines in the Cripple Creek District, and situated at Canon City, Colorado. (Ill.) 3 cols.—*Mod. Machy.*, July, 1900.

—— *The Snoqwalmie Falls Power Development.* Description of plant utilising the power of the Snoqwalmie Falls, 23 miles from Seattle, Wash., U.S.A., one of the most famous sights of the Pujit Sound region, purchased in 1897 by Mr. Charles W. Baker, and now supplying current already to Seattle. 3½ cols.—*Engrg. Rcd.*, July 7th, 1900.

—— *The Electric Lighting and Tramways of Buenos Ayres.* Description of a plant, the nucleus of which was formed by the private firm of Sr. Rufino Varela, which owned two small stations, one for a direct current system of 250 units capacity in the Opera House, and the other for a mixed alternating and direct current at the rear of the Politeama Theatre, almost all the theatres being supplied by one of these two stations. In 1897 the Cia. Generale de Electricidad was formed in Paris to develop the concessions of Sr. Rufino Varela with a capital of 6,000,000 frs., which erected the new plant. (Ill.) 5 cols.—*Elec. Rev.*, July 13th, 1900.

Motors.—*Alternating-Current Induction Motors.* By A. C. Eborall, Assoc. Abstract of a paper read before the Institution of Electrical Engineers, in which the author gives some practical hints connected with the design, construction, and performance of modern single and polyphase induction motors. (To be continued.) 4½ cols.—*Elec. Engr.*, July 20th, 1900.

Power Stations.—*Some General Conditions Governing Power Station Design.* Abstract of a paper by Mr. Philip Dawson, read before the Tramways and Light Railways Association on June 25th, treating the question from the important point of view of economy. 4 cols.—*Mech. Engr.*, July 7th, 1900. (Concluded.) 5½ cols. July 14th, 1900.

Rotary Converters.—*The Starting of Rotary Converters.* The article deals with the best methods of starting rotary converters, which, so far as the alternating-current supply is concerned, are in reality synchronous motors, and consequently subject to the difficulties of starting inherent in this type of machine. 2 cols.—*Street Ry. Journ.*, July, 1900.

4. Telegraphy and Telephony.

Cables.—*Submarine Cables.* By M. P. Marcillac. This is an interesting monograph in the first portion of which the author describes the apparatus used and the methods of sending cable message, while the second portion deals with the cable lines owned by various nations and their management. 41 pp.—*Bull. Soc. Scient. Ind. de Marseilles.* First Trimester, 1900.

Cable Signalling.—*A Practical Transmitter using the Sine Wave for Cable Telegraphy; and Measurements with Alternating Currents upon an Atlantic Cable.* By A. C. Cashore and G. O. Squier. Abstract of a paper read before the American Institute of Electrical Engineers, May 17th, 1900. The paper describes a method of utilising the sine wave of electro-motive force for cable signalling, and a practical cable transmitter embodying these principles, thus making available the ordinary methods of measurement such as are used on power transmission lines, and some results are given of such measurements upon submarine cables. 11 cols.—*Elec. Rev.*, June 20th, 1900.

Telegraphy.—*Multiple Reversible or Multiplex Telegraphy, Mercadier System.* Account of a system invented by M. E. Mercadier, Professor at the High School of Telegraphy and Director of Instruction at the Polytechnic School at Paris, which makes it possible to send over one wire as many as 24 telegrams, 12 in each direction, without any risk of confusing the signals. This system has been presented to the Academy of Science by M. Cornu, and can be seen in operation at present at the Paris Exhibition. 2½ cols.—*Génie Civil*, June 16th, 1900.

—— *Arrangement intended to Prevent the Interception of Dispatches in Wireless Telegraphy.* By Dr. T. Tommasi. The author describes an arrangement designed by him to prevent the message sent out by the transmitting apparatus of a telegraph station from being deciphered by a receiving apparatus at an intermediate point. 1¼ col.—*Elec. Rev.*, July 13th, 1900.

—— *The Te'autograph.* Description of an instrument invented by Mr. Foster-Ritchie, and exhibited at the British Telautograph Co.'s premises, serving to reproduce at a distance writing or drawings quite automatically and with remarkable accuracy. The actual working is kept secret as yet, owing to the fact that patents have not yet been secured abroad for some of the details. (Ill.) 1 col.—*Elec. Engr.*, July 27th, 1900.

5. Miscellaneous.

Electric Appliances.—*Safety System of Electric Water-tight Doors.* Description of a system of water-tight doors for the bulk head of ships, worked by

electricity after a method invented by Naval-Constructor Francis T. Bowles and embodied in the construction of doors by the Sprague Electric Company of New York. 1¾ col.—*West. Elect'n.*, June 23rd, 1900.

Electrical Applications.—*Electrically-driven Printers' Machinery.* Description of the "Holmes Clatworthy System" for driving printing presses, utilised in the printing offices of various London newspapers, in which two motors are used, controlled by a specially designed switch. (Ill.) 5 cols.—*Engr.*, July 13th, 1900.

Electric Measurements.—*Electrical Measuring Instruments.* By J. Franklin Stevens. The author, pointing out that there is a very extensive literature available on the subject of laboratory testing experiments, confines his paper to a discussion of the commercial direct-reading indicating instruments. (To be concluded.) 8 cols. and 6 cols. respectively.—*Elec. Rev.*, July 4th and 11th, 1900.

—— *A Frictionless Electric Meter.* Description of a motor meter invented by Mr. Sidney Evershed and described by him some time ago in a paper read before the British Institution of Electrical Engineers, its superiority over others being that friction has been practically eliminated. (Ill.) 3 cols.—*Elec. Rev.* (New York), July 11th, 1900.

—— *A New Type of Mercury Interrupter.* By Eugene W. Caldwell. Description of a new form of interrupter which appears to have advantages over other mercury or liquid interrupters for operating induction coils, and differs from them in so far as the break is made between two surfaces of mercury instead of between a terminal of mercury and another of platinum or other metal, the air is completely excluded from the contact points so that no oxidation takes place where the brake occurs, the break is made below the surface of the liquid where the metal is clean instead of at the surface where the imperfectly conducting oxides and other impurities collect. (Ill.) 1¾ col.—*Elec. Rev.* (New York), June 20th, 1900.

Electric Works.—*New Works of the English Electric Manufacturing Company, Limited.* This is another of the many descriptions that have recently appeared in the technical press, referring to this new and successful manufacturing enterprise. 14 cols.—*Tramw. & Ry. Wrld.*, July 5th, 1900.

—— *Works of the Bullock Electric Manufacturing Company.* Description of a manufacturing plant which is of special interest as representing the most modern development of electric-driving, being that of the Bullock Electric Manufacturing Company, situated at East Norwood, a beautiful suburb of Cincinnati, O., U.S.A. (Ill.) 3 cols.—*Am. Mech.*, June 14th, 1900.

—— *Westinghouse Electric Factory at Havre, France.* Description of the plant and equipment of the *Société Industrielle d'Electricité Procédés Westinghouse*, at Havre. Starting with a capital of £400,000, the company has already orders which will require a year and a half to complete. (Ill.) 2½ cols.—*Street Ry. Journ.*, July, 1900.

Interrupters.—*The Applications of the New Electric Interrupter for the Production of X-Rays and for Wireless Telegraphy.* By M. A. Perot. The author shows that the vacuum tubes existed by means of the Wehnelt Interrupter are unusually brilliant, and images produced by radioscopy in this way are excellent, and as regards wireless telegraphy, where in order to obtain correct transmission of the signals, it is necessary that the emission of waves, *i.e.*, the discharge of the oscillator should be accomplished with ease, the Wehnelt Interrupter is extremely useful both in view of its instantaneous action and its copious discharge of sparks. 7 cols.—*Bulletin Soc. Scient. Industr. de Marseille*, Second Trimester, 1899.

MARINE ENGINEERING AND SHIPBUILDING.

1. Merchant Vessels.

Steamers.—*The Twin-screw Channel Steamer "Alberta."* The article deals with a new twin-screw Channel steamer, *Alberta*, specially built for the Paris Exhibition traffic between Southampton and Havre, a route which has grown greatly in favour, since it enables passengers to leave London late at night, have a night's rest, with all the comforts of an Atlantic liner, and arrive early next day in Paris. 2 cols. *Engrg.*, July 13th, 1900.

Steamers.—*Twin-screw Steamboat "Pennsylvania."*—Description of an unusually interesting vessel, the twin-screw steamer, *Pennsylvania*, recently put into service on the waters of Chesapeake Bay. Her chief point of interest is that she has a modified torpedo boat or knuckle stern. The stern of the *Pennsylvania* differs from the regular torpedo boat stern in that it has practically two sterns divided at the knuckle, in the same style as the English Channel steamer *Tamise*, of 1,000 tons. The *Pennsylvania* was designed by naval architects Gardner and Cox, of New York, and built at the Roach Yard, Chester, Pa. (Ill.) 4½ cols.—*Mar. Engrg.*, July, 1900.

—— *New York's Passenger Steamboats in 1850.*—Description of a very fine and interesting passenger fleet, although steamships at that period were still in their infancy, and containing some vessels that even to-day would attract attention. 5½ cols. *Naut. Gaz.*, July 12th, 1900.

Steamships.—*The Latest Addition to the Union-Castle Line Fleet.* Description of the new twin-screw steamer *Saxon*, of the Union-Castle fleet of Cape steamers, being only 30 tons short of 13,000 tons, and fitted up with great luxury and completeness. (Ill.) 1¾ col.—*Steamship*, July, 1900.

—— *The "Saxon."* Description of a modern steamer of special interest, as being, though not laid down for the new Union-Castle Line, the first steamer completed for this line. The *Saxon* started on her maiden trip from Southampton on June 16th to the Cape, and has a gross tonnage of 12,970, and is, of course, a twin-screw vessel. (Ill.) 5 cols. *Mar. Engr.*, July 1st, 1900.

—— *The Allan Line Steamships "Bavarian" and "Tunisian."*—Description of two modern steamers, the *Bavarian*, built last year by Messrs. Denny & Brothers, Dumbarton, a twin-screw vessel, of 10,200 tons, 520 ft. long, 59 ft. beam, and 43 ft. in depth; the *Tunisian*, built by Messrs. Alexander Stephen & Sons, Linthouse, launched on the 17th January last, a twin-screw steamer of 10,200 tons, 520 ft. long, 59 ft. beam, and 43 ft. in depth. (Ill.) 3 cols. *Steamship*, July, 1900.

2. Pleasure Craft.

Yachting.—*Yachting and the Construction of Fishing Barks.* Description of the gradual evolution of the form of the fishing barks in the Port of Sables d'Olonne, which originally being needed for service near the coast only had a very different appearance, but when it became necessary to make longer journeys in order to secure fishes were changed into sea-going barks, and have lately assumed the form of pleasure yachts owing to the initiative of a shipbuilder by the name of Louis Fontane. (To be continued.). (Ill.)—*Le Yacht*, July 28th, 1900.

3. Equipment and Machinery.

Four-Crank Engines.—*Improvements on the Four-Crank Engine, with Advantages when Fitted with the Clyde Patent Combined Balancer Piston Valve.* Abstract of a paper read at the Glasgow Branch of the Marine Engineers' Association by William O'Brien, consulting engineer. (ill.) 3 cols.—*Mar. Engrs'. Ass. Monthly Rep.*, July, 1900.

4. Docks.

Docks.—*Naval Docks of the United States.* Description of the floating dry dock at Havana, sold by the Spanish Government to the United States, which will be transferred to some other port, and of the gigantic new dock to be stationed at Algiers, La., U.S.A., which will place the United States first among nations as far as dry-dock accommodation is concerned. (Ill.) 3 cols.—*Am. Mfrr.*, June 28th, 1900.

5. Miscellaneous.

Coaling at Sea.—*Miller System of Coaling at Sea.* Description of the method devised and the apparatus invented by Mr. Spencer Miller for coaling vessels at sea, adopted by the United States Navy Department, and capable of transferring from the collier to the war-vessel 20 tons of coal per hour. 2 cols.—*Iron and Coal Trds. Rev.*, July 13th, 1900.

Handling Bulk Cargoes.—*Equipment for Handling Bulk Cargoes Rapidly at Great Lake Ports.*—I. By Arthur C. Johnson. Abstract of a paper read before the Civil Engineers' Club of Cleveland, Oh., U.S.A. The paper deals with the special types of machinery built for the purpose of "quick dispatch" in loading and unloading the enormous tonnage of ore and coal that is shipped annually on the Great Lakes—the foundation of the gigantic steel industry that has made the United States a competitor in the markets of the world. The article is accompanied by a map and illustrations. 3½ cols.—*Mar. Engrg.*, July, 1900.

Shipyard Plant.—*Patent Shipyard Plant by Hugh Smith & Co., Glasgow.* Description of a double shipplate scarping machine, the special feature of which is that it is designed to turn out double the work of an ordinary scarping machine, and of an improved hydraulic joggling machine, being a combined hydraulic angle-bar and plate-joggling machine. This tool is to be used for joggling angle bars or bulk angles for ships' frames. (Ill.) 1 col.—*Steamship*, July, 1900.

MECHANICAL ENGINEERING.

1. Boilers, Furnaces, and Fuel.

Blast Furnaces.—*The New Blast-Furnace Installation of the Millom and Askam Hematite Iron Company, Ltd.* Description of an interesting plant, consisting of ten furnaces of the standard English type, six of which are located at Millom, being 70 ft. high each, and limited at present to a bosh diameter of 19 ft. 6 in., with a 9 ft. hearth, each being blown by 6 in. tuyères. The remaining four furnaces are located at Askam, and, when built, were considered the largest furnaces in the world, being 75 ft. high, with 32 ft diameter of shell; at present they are limited to a bosh diameter of 19 ft. 6 in., with 9 ft. hearth. (Ill.) 1¾ col.—*Iron and Coal Trds. Rev.*, June 29th, 1900.

Boilers.—*Water-tube Boilers in the Navy.* Digest of the Admiralty memorandum respecting water-tube boilers in the Navy, mainly dealing with the Belleville type of steam generator, and intimating that since, by the adoption of water-tube boilers, working steam pressures of from 150 to 250 lbs. were rendered available, alterations were made in the engines and auxiliary machinery which proved to be the main cause of the difficulties that have since arisen. 2½ cols.—*Meck. Wrld.*, July 20th, 1900.

—— *The Admiralty Memorandum on Water-tube Boilers.* Digest of a memorandum on the Belleville class of water-tube boilers issued by the Admiralty, showing that the defects which have made such a stir have been more or less of a kind which can be surmounted, and do not reflect to the extent which, in some quarters, has been imagined, upon the general wisdom of the Admiralty in adopting water-tube boilers. 2½ cols.—*Mech. Engr.*, July 21st, 1900.

—— *Water-tube Boilers Select Committee.* The article compliments Mr. Goschen on having met the question frankly, and thinks that now that a committee of inquiry has been appointed it is hardly necessary to discuss the question at present; the strongest criticism that could be brought to bear against the Admiralty being that in their adoption of the water-tube boiler they have perhaps been too precipitate. 1 col. *Mech. Engr.*, July 21st, 1900.

—— *Safety Boiler Feeder.* Description of a device patented by Mr. Franz J. Weiss, of Basle, Switzerland, for supplying feed-water to boilers, constituting a safety boiler feeder. (Ill.) 2 cols.—*Mod. Machy.*, July, 1900.

Boiler Shops.—*The Arrangement of Boiler Shops.* The author justly thinks that there can be no doubt about the usefulness and necessity of studying the progress made in boiler shop design, and then proceeds to point out the various features of improvement, illustrating them with reference to actual practice, without giving names, however. 2½ cols.—*Mech. Wrld.*, July 6th, 1900.

Boiler Shops.—*The Manufacture of the Belleville Boiler.* An article describing the manufacture of this well-known type of boiler, which recently has given so much cause for discussion, in the famous works of John Penn and Sons, now owned by the Thames Ironworks Shipbuilding and Engineering Company, Ltd. 3½ cols.—*Marine Engr.*, July 1st, 1900.

—— *The Manufacture of Cold-Drawn Steel Tubes.* The article describes the method of manufacturing cold-drawn steel tubes in use at the Shelby Steel Tube Company's works at Shelby, O., U.S.A., at the junction of the Big Forest and Baltimore and Ohio Railroads. (Ill.) 2 cols.—*Ry. Age*, June 15th, 1900.

Exhaust Steam.—*Utilisation of Exhaust Steam for Heating.* By Harry J. Triths. Abstract of a paper read before the National Electric Light Association at Chicago, May 22nd, 1900, in which the author dwells on the great economy resulting from the utilisation of exhaust steam. 2½ cols.—*West. Elect'n.*, June 9th, 1900.

Feed-Water Heaters.—*Largest Installations in the World in Western Pennsylvania. Growth of the Business.* The article shows that in Western Pennsylvania, where fuel is cheaper than elsewhere in the world, feed-water heaters have become an indispensable adjunct of steam plants, and are built with extraordinary dimensions, one of them in operation at the armour-plate department, Homestead Steel Works, of the Carnegie Steel Company, giving 5,000 h.p., and being, moreover, only one of eight of the same size, while the Pittsburg Feed-Water Heater Company has installed heaters of from 25 to 10,000 h.-p., the latter, the largest in use, being built for the Carnegie Steel Company. (Ill.) 1½ col.—*Am. Mfrr.*, July 12th, 1900.

Fuel.—*Coke for Locomotive Fuel.* By George L. Fowler. The author first reviews briefly European practice, and then describes in detail its use in the United States, and its advantages for locomotive fuel. (Ill.) 3½ cols.—*Rail. Gaz.*, June 22nd, 1900.

—— *The Use of Oil in Metallurgical Furnaces in Russia.* Abstract of an article in *Stahl und Eisen*, in which the methods of using coal oil in metallurgical furnaces are described in detail, and the advantages and drawbacks of the various systems are discussed. 2½ cols.—*Engrg. & Min. Journ*, June 23rd, 1900.

—— *Utilisation of Bagasse as Fuel.* George P. Anderton. The author discusses the best means of getting the full value as a fuel of "bagasse" from sugar cane, which is used for steam-raising by Louisiana planters, and which, when made from cane with 10 per cent. of fibre with an extraction of 75 per cent., is composed of: water 51 per cent., fibre 40 per cent., sugar 6 per cent., molasses (dry matter only) 3 per cent. 1½ col. *Am. Mfrr.*, June 28th, 1900.

Fuel Tests. *The Berthier Method of Coal Calorimetry.* By C. V. Kerr. Abstract of a paper read before the Am. Soc. of M. Engrs., in which the author recommends and describes a method of calorimetry which uses oxide of lead (Pb O) as the source of oxygen. 5½ cols. *Power*, June, 1900.

Steam Economy.—*Saving by Superheated Steam.* By R. S. Hale. The author gives a short history of the improvements made in the steam engine to increase its efficiency, and dwells on the merits of Him, who, in 1850, first demonstrated the practical economy obtained by using superheated steam. He then gives a short account of the various forms of superheaters. 1¾ col.—*Mech. Wrld.*, June 29th, 1900.

2. Compressed Air.

Air Compressor.—*Electrically-Driven Air Compressor.* The article contains a description of a machine manufactured by Reavill & Co., Ltd., and destined for one of the works of Vickers, Sons, & Maxim, to which

firm it is being supplied along with a number of pneumatic tools by the New Taite-Howard Pneumatic Tool Company. (Ill.) 2½ cols.—*Engr.*, June 29th, 1900.

3. Engines and Motors.

Automobiles.—*A Military Automobile.* Description of the Pennington war automobile, designed and built with the idea of carrying a couple of maxims or colts with their detachment rapidly into action, and for this purpose it is provided with engines of exceptional power and with a belt of armour. It has been constructed with a low centre of gravity, and its bulk has been reduced to the smallest dimensions consistent with the duties it has to perform. (Ill.) 1 col.—*Sci. Am.*, June 30th, 1900.

—— *Lawson's Three-Wheeled Car.* The article gives a description of a very neat little car permitting two passengers to sit side by side quite comfortably. The car is to be put upon the market for the remarkably low price of nine pounds sterling, a price possible only in consequence of the very compact and unpretending but quite reliable mechanism, and the large demand which its appearance promises to create. (Ill.) 1½ col.—*Autom. Journ.*, July 14th, 1900.

—— *Automobile Carriages at the Paris Exhibition, No.* 1. The author gives a concise description of the more typical automobiles exhibited, making a selection among the number of almost 200, divided between the exhibition at the Champ de Mars, and the Vincennes annexe. 2 cols.—*Engr.*, July 20th, 1900.

—— *Automobiles as a Source of Revenue for Central Stations.* Abstract of a paper by Mr. Elmer A. Sperry, in which the author points out the great advantages to be obtained from the fact that electricity can be stored, and the benefits that central stations may derive from supplying automotor cars. 3⅓ cols. and 4 cols. respectively.—*Electricity* (N.Y.), June 27th and July 4th, 1900.

Engines.—*Test of a Triple-Expansion Pumping Engine.* By W. F. M. Goss. Description of tests of an engine designed and constructed by the Snow Steam Pump Works for the Indianapolis Water Company, Indianapolis, Ind., U.S.A., its function being to draw water from a "reservoir" or "gallery" near the engine and to deliver the same to the mains supplying the city. (Ill.) 3⅓ cols. (To be continued.) *Mech. Engr.*, July 7th, 1900.

—— *The International Tramways and Light Railways Exhibition.* The article gives a general outline of the exhibition and a more detailed reference to a Smith-Vaile Jet Condenser, Nell's Direct-connected Engine and Generator built for the Glengarnock Iron and Steel Company, Nell's Double-acting Triplex Pump, A. Haacke & Co.'s boiler coverings, etc. (Ill.) 3 cols.—*Iron.*

—— *Vapour Engines.* By "Precursor." The article gives a short historical summary of various devices invented to add to the efficiency of the steam engine by the employment of waste heat, or by producing an engine to be employed as prime-mover and to be operated by vapours of some description to take the place of the older motor, and concludes by stating that the well-known engine recently invented by Messrs. Behrend and Zimmermann must be of a somewhat limited utility. 1½ col.—*Autom. Journ.*, July 14th, 1900.

—— *Cylinder Condensation.* The author of this article, which is a reprint from the *Electrical Review*, points out that the interaction of the metal of a steam engine and of the working cylinder has received but little attention from engineers and is often not understood, that Watt must have had clear ideas of steam-engine economy, and, finally, dwells on the important part played by cylinder condensation. 1½ col.—*Mech. Wrld.*, June 22nd, 1900.

—— *Corliss Steam Engine with Valves.* Description of a Corliss Engine by the Maschinenbau Actien-Gesellschaft, of Prague, at the Paris Exhibition. (Ill.) 2 cols.—*Génie Civil*, July 14th, 1900.

—— *The Balancing of Engines.* By J. Macfarlane Gray, late chief examiner for the Board of Trade, read before the Institute of Marine Engineers. A very interesting and valuable paper on the subject, treating it in a very lucid and elegant style, and in a manner such that even those who had no special mathematical training can comprehend it. (Ill.) 6½ cols.—*Steamship*, July, 1900.

Engines.—*Cylinder Proportions for Compound and Triple-Expansion Engines.* By B. C. Ball. The author points out that, although the subject is discussed in innumerable publications, the solution of the question whether there shall be terminal drop in any but the last cylinders is still open, though the weight of authority, especially among the older engineers, seems to answer this in the negative. (Ill.) 7½ cols.—*Mech. Engr.*, July 21st, 1900.

—— *Economy of Simple or Compound Engines for Traction.* By W. H. Booth. This article, reproduced from the *Electrical Review*, endeavours to show the superiority of simple engines under some conditions of electric traction. 2⅝ cols.

Gas Engines.—*Trial of 650 H.-P. Gas Engine.* The article contains particulars of tests made in March, 1900, on a 650 h.-p. simplex gas engine, driven by high furnace gases at Seraing, Belgium, one of three horizontal simplex motors recently constructed by the Société Cockerill at Seraing. (Ill.) 2 cols.—*Engr.*, June 29th, 1900.

—— *Gas Engine Design*—8. By E. W. Roberts. The present instalment of this contribution is devoted to igniters and their classification, and gives a brief outline of the various methods that have been in use and are now employed, pointing out the inherent defects of each method. (Ill.) 4½ cols.—*Am. Machy.*, July, 1900.

—— *Premature Ignition in Gas Engines.* By E. W. Roberts, M.E. The author points out that no detail gives to gas-engine builders so much trouble as an appropriate arrangement for lighting the charge, and that premature combustion is a most prevalent effect. He discusses the causes, and indicates remedies. 3⅝ cols. —*Mod. Machy.*, July, 1900.

—— *The Gas Engine Hot Tube as an Ignition Timing Device.* By Wm. Magruder. Extracts from a paper read before the American Society of Mechanical Engineers. The author describes the results of experiments made with a 9 i.h.-p. engine, working at 7 i.h.-p. when using natural gas, and comes to the conclusion that hot tube ignition is not preferable to electric, though other engines may probably not show so many ailments as the one experimented with, so that the results obtained are not quite conclusive. 4½ cols.—*Autom. Journ.*, July 14th, 1900.

—— *Converting Gas Motors into Oil Engines.* Description of a method devised by Mr. Herbert C. Capel, of London, for the purpose of converting existing gas engines into oil engines, comprising means for drawing off the required quantity of oil into the vaporiser by the suction produced by the movement of the piston when drawing into the cylinder the air required to mix with the vapour. (Ill.) 1½ col.—*Mod. Machy.*, July, 1900.

—— *Gas Engine Experiments.* By Prof. W. W. F. Pullen. The author describes the results of a series of four progressive gas engine trials with different loads, carried out during one evening by three of the author's students; the engine being one by a well-known firm giving at maximum load and with ordinary lighting gas about 5 b.h.-p. at 200 revolutions per minute; each of the trials lasted ten minutes, and the gas was measured by an ordinary dry gas meter. (Ill.) 8 cols.—*Mech. Engr.*, July 7th, 1900.

—— *Gas Engines for Tramway Power Stations.* The article summarises the salient features of gas engine construction and of that of the Westinghouse type in particular, and gives the chief facts referring to the use of gas engines in electrical central stations and its advantages. (Ill.) 11½ cols. — *Tramw. & Railw. Wrld.*, July 5th, 1900.

Valves.—*Tests of Westinghouse and New York Triple Valves.* Description of a series of tests made by the *Railroad Gazette*, in which was used the excellent rack of the American Brake Co. at St. Louis, Mo., and which resulted in showing that the Westinghouse triple valves conform to the requirements of the Master Car Builders' Association, while in several important respects the New York Triples do not so conform. 10½ cols.—*Railroad Gaz.*, June 15th, 1900.

Valves.—*The Valves of Internal Combustion Engines.* By James D. Roots, M.I. Mech.I. The author points out that he does not wish to deal with valves considered experimentally, but rather with existing practice, and draws attention to the fact that the valves of these engines, whether gas, oil or spirit, are among the most important of their parts. (Ill.) 3¼ cols.—*Engr.*, July 4th, 1900.

4. Power and Transmission.

Air Pump.—*An Independent Condenser and Air Pump for Ten Thousand Horse-Power.*—Description of an apparatus designed and constructed by the Conover Manufacturing Co., of New York, and containing some novel features; these condensers and air pumps are designed for 10,000 h.p. of engines. 1⅔ col.—*Power*, June, 1900.

Excavating Machines.—*Some recent French Excavating Machines.* Description of some new excavating machines, some being designed and built by Mr. Richard Dalton, of Wilmeth, Ill., U.S.A., and another designed and patented by Mr. Harvey C. Lowrie, M.Am.Soc.C.E., of Denver, Colo., U.S.A. (Ill.) 1⅔ col.—*Engrs. News*, July 12th, 1900.

Power Press.—*Powerful Bliss Press.* The article describes what is probably the largest and heaviest one-piece frame machine of its class ever made, the frame casting alone weighing nearly 16 tons, the other details being in proper proportions, the eccentric being 15½ ins. in diameter, giving the main shaft a stroke of six inches. This press is so accurate that the finest watch hand cutting could be worked in it, notwithstanding it being designed for unusually heavy work by the makers, who are the E. W. Bliss Company, of Brooklyn, N.Y., U.S.A., (Ill.) 1 col.—*Am. Mftr.*, June 28th, 1900.

5. Machine Works, Shop and Foundry.

Foundries.—*Foundry Management.* By James A. Murphy, Elizabethport, N.J. Abstract of a paper presented at the Chicago meeting of the Foundrymen's Association. The author discusses ably the requirements of management, materials, and tools, though in a somewhat rough and ready style. 2⅔ cols.—*Iron & Steel Trds. Rev.*, July 7th, 1900.

6. Tools.

Diamond Saw.—*Diamond Saw for Stone Cutting.* The article contains a concise description of a diamond saw, lately introduced by Messrs. George Anderson & Co., of Carnoustie, N.B., exhibited at the York Show of the Royal Agricultural Society of England, cutting hard stone blocks at the rate of 5 ins. per minute. (Ill.) ⅔ col.—*Engrg.*, June 29th, 1900.

Drifting Machines.—*Improved Drifting Machines.* Description of a machine produced by the Britannia Company, Colchester, which, although specially designed for drifting the oval holes in the junction boxes of Belleville Boilers is also suitable for varied work of a similar character. (Ill.) ½ col.—*Mech. Wrld.*, June 15th, 1900.

Machine Tools.—*Machinery at the Paris International Exhibition*, 1900. Article dealing comprehensively with the most interesting specimens of machinery from all parts of the world, introduced by a few general remarks in which the author expresses regret that as regards exhibits of this kind Great Britain is excelled not only by France, but also by Germany and the United States. To the latter, he says, must be awarded the palm of ingenuity, the American machines are mostly automatic; though among the limited number of exhibits from Great Britain are many showing that British manufacturers obtain the same results in a less complicated manner, and their machinery, moreover, is far more solid. (Ill.) 26 cols.—*Ironmonger*, July 28th, 1900.

—— *Some New Machine Tools.* Description of various new machine tools constructed by Messrs. Webster & Bennet, of Coventry, among them a 36-in. boring and turning mill, a 4-spindle drilling machine, another handy drilling machine of special design, and a vertical profile milling machine. (Ill.) 2 cols.—*Mech. Engr.*, July 14th, 1900.

Machine Tools.—*A Power Screw Press.* Description of a screw press made principally for the manufacture of shovels and goods of that character; it is designed and built by the Toledo Machinery Tool Company, Toledo, O., U.S.A. ⅔ col.—*Am. Mach.*, June 14th, 1900.

—— *An Inertia Valve Percussion Tool.* By Chester B. Albree. Abstract of a paper read before the Engineers' Society of Western Pennsylvania, U.S.A., in which the author demonstrates, that after ascertaining the velocities and the volumes of the motive fluid, and the number of strokes per minute, the amount of air consumption can be closely approximated, and a tool can be intelligently designed to do the work expected of it as regards force of blow, frequency of stroke and air consumption at any given pressure. 6½ cols.—*Mech. Engr.*, July 7th, 1900.

—— *An Inertia Valve Percussion Tool.* Digest of a paper recently read by Mr. Chester B. Albree before the Engineers' Society of Western Pennsylvania, in which the author describes the gradual evolution of the modern pneumatic hammers from the hand hammer, the ancient catapult, and deals with the principles involved, and the results attained in the improvements, ending with an account of a direct-acting inertia valve hammer. (Ill.) 2⅔ cols.—*Iron & Coal Trds. Rev.*, July 13th, 1900.

—— *Design and Construction of Machine Tools.* By Thomas R. Shaw. The article deals fully with the important question of the manufacture of machine tools in which Great Britain formerly held the supremacy, but which of late has been seriously jeopardised by American competition. (To be continued.) (Ill.) 6½ cols. —*Mach. Engr.*, July 28th, 1900.

Nail-Making Machine.—*A Novel Nail-Forming Machine.* Description of an ingenious apparatus for rolling nails from a continuous length of stock, devised by Mr. Sextus L. Reed of Gallantin, Tenn., especially designed to produce a triangular rail, although other forms also can be made. (Ill.) ⅔ col.—*Sci. Am.*, July 14th, 1900.

Shapers.—*Large Travelling Head Shaper.* Description of a travelling head shaper, weighing 16 tons, built by the Morton Manufacturing Co., Muskegon Heights, Mich., having the distinguishing characteristic of shapers built by that company, that it operates on the pull or draw-cut principle, the cutting stroke being during what is ordinarily called, the return stroke in the common type of shapers; the effect of this construction being to draw together the different parts of which the shaper is composed—to close the joints, as it were—while the cut is in progress, and the harder the machine is worked, the more rigid becomes the tools. In this way an unusually long shaper ram can be used without vibration. (Ill.) 2½ cols.—*Am. Machy.*, July, 1900.

7. Refrigeration and Cold Storage.

Refrigeration.—*Cheese Cooling.* Description of an ice rack for cheese factories, of which a description, accompanied by a useful drawing, is published by the Canadian Department of Agriculture. (Ill.) ½ col.—*Cold Storage*, July 15th, 1900.

—— *Ice Making in South Wales.* The present article deals with the Cardiff Pure Ice and Cold Storage Co., Ltd.'s plant and equipment, which owes its existence to the enterprise of Messrs. Neale and West, fish merchants at Cardiff. 5½ cols.—*Ice & Cold Strge.*, July, 1900.

—— *Overhauling and Repair of Cooling Plants.* By Constanz Schmitz, engineer, Berlin. Translation of an article published by the author in *Eis und Kälte Industrie*, indicating the most suitable methods of overhauling refrigerating plant after the summer's work. (Ill.) 5 cols.—*Ice & Cold Strge.*, July, 1900.

—— *The De Beers Co.'s Cold Stores.* Description of that company's plant at Woodstock, which forms one of the most interesting and complete refrigerating establishments in any country, and which was designed by Mr. E. J. Greenstreet, resembling, as regards general arrangements, in relation and machinery, those used in Australia, New Zealand and America. 2 cols.—*Ice & Cold Strge.*, July, 1900.

Refrigeration.—*The Star Ice Company.* Description of an interesting device invented by Mr. Van der Weyde for marking their ice by means of a star, so as to distinguish it from ice of a contaminated character, and used in the factory of the London Star Ice Company, Ltd. (Ill.) 3½ cols.—*Ice and Cold Storage*, July, 1900.

—— *Ice-making and Refrigerating Machinery at the Paris Exhibition.* This article is printed as a supplement of the paper below quoted, and contains a very full account of the refrigerating machinery exhibited at the Paris Exhibition, being accompanied by many illustrations. 18 cols.—*Ice and Cold Storage*, July, 1900.

—— *Refrigerating Machinery at the Paris Exhibition.* The present instalment deals mainly with the exhibits of Messrs. Raoul Pictet Processes, Ltd., and of those of Messrs. Douane. (To be continued.) 2 cols.—*Cold Storage*, July 15, 1900.

8. Miscellaneous.

Chimney Construction.—*The Height and Area required for Chimney Draught.* By H. G. Brinckerhoff. Abstract of a paper read before the New England Cotton Manufacturers' Association, in which the author establishes on the sound basis of mathematical and physical laws a theory for calculating the proper height and area of a chimney so as to secure sufficient draught. 4½ cols.—*Power*, June, 1900.

Cost of Power.—*The Value of a Horse-Power.* By A. Samuel Webber. Abstract of a paper presented to the American Cotton Manufacturers' Association, in which the author discusses the question of the cost of a horse-power in various places, draws comparison between the cost in small plants and in large plants, and finally comes to the conclusion that no general standard for the value of a horse-power can be determined, and that it is a matter which is controlled by situation, circumstances, and demand. 2½ cols.—*Power*, July, 1900.

Cylinder Head Studs.—*The Tension in Cylinder Head Studs.* By W. F. Durand. The author of this article, reproduced from the *Sibley Journal of Engineering*, discusses the relation of the initial tension on the bolt, due to setting up the nut, to the final resultant stress, when the bolts are carrying the steam load, arriving in connection with the design of stud bolts for cylinder heads, &c. (Ill.) 1½ col. *Mech. Wrld.*, July 19th, 1900.

Piston Valves.—*The American Balance Piston Valve.* Description of interesting improvements in piston valves introduced by the American Balance Valve Company, and to be tried shortly by the Chicago & North-Western Railway, the object of the innovation being to combine the desirable features of the plug valves with facilities for automatic adjustment to the bore of the valve-chamber, to obtain ample bearing surface of the packing rings by numbers of wide rings with absolute protection against the inside rings. (Ill.) 1 col.—*Am. Engr. and R. R. Journ.*, July, 1900.

Printing Machinery.—*Some Printing Machines at the Paris Exhibition.* The present article is mainly devoted to a description of an enormous rotary cylindrical multi-colour press exhibited by the Machinen Fabrik of Augsburg, in Bavaria. (Ill.) 2½ cols.—*Engrg.*, June 29th, 1900

Timber-Working Machinery.—*Timber at the Paris Exhibition (Machinery Section).* This section of the supplement deals with timber-working machinery, describing, among others, the exhibit of Messrs. A. Ransome & Co., Ltd., the well-known sawmill engineers, who have a fine display of wood-working machinery in operation, illustrating the types they will manufacture at their new works at Newark-on-Trent, as, for instance, the "Marbut" Rapid Moulding Carver, Ransome's Patent Steam Cross-Cut Saw for logs, a 36-in. Roller-Feed Circular Saw Bench, etc.; the exhibit of the Fay & Egan Company, including a "Lightning" Flooring Machine; the exhibit of Messrs. Sussfeld, Lorsch & Co., of Paris and New York; and, including a splendid collection of American machines, to mention only a planing machine built by the H. B. Smith Company, a tenoning machine, two mortising machines, and a sandpapering machine, etc., by the same makers; some large band-saws made by Connell & Dengler; the exhibit of the Simonds' Manufacturing Co., of Fitchburg, New York, U.S.A., consisting mostly of saws and mechanical knives, etc. (Ill.) 7 cols.—*Timber Trds. Journ.* (Supplement), July 21st, 1900.

MINING AND METALLURGY.

1. Coal and Coke.

Coal Mining.—*The Coal Reserves at the Close of the Nineteenth Century.* By Prof. Edward Holl, LL.D., F.R.S. Digest of an address delivered on the subject at the annual meeting of the Victoria Institute, London, in which the author, though taking no alarmist view of the matter, seems to think that there is cause for a serious investigation of the subject, and favours an export duty of not less than five shillings per ton, as well as the appointment of a Royal Commission (1) to investigate the quantity of coal available for naval and commercial purposes, (2) to ascertain the area of the concealed coalfields, (3) to report whether means should be taken to prevent the too rapid exhaustion of British coal, (4) to inquire how far an additional rise in the price of coal would place our manufacturers at a disadvantage. 2½ cols.—*Iron & Coal Trds. Rev.*, July 20th, 1900.

—— *Coal Mining at the Paris Exhibition.* The article deals very fully with the mining exhibits in the Paris Exhibition, most of which are installed in a large building in the Champ de Mars, close by the Eiffel Tower, and of which France, notwithstanding her limited mining industry, shows an admirable display. (Ill.) 18¾ cols.—*Iron & Coal Trds. Rev.*, June 29th, 1900.

Coal Transporter.—*The Temperley Transporter.* Description of a very efficient transporter, designed and constructed by Mr. John R. Temperley, for many years engaged by the War Office in connection with torpedo work, and Mr. S. M. Cockburn, manager of the Temperley Transporter Co. (Ill.) 4½ cols.—*Engr.*, June 22nd, 1900.

Collieries.—*Running Collieries Entirely by Electricity from One Centre.* By Sidney W. Walker. The author describes an electrical plant to be used in collieries, showing how the energy liberated by the combustion of coal can be utilised and reconverted at a much greater advantage when the coal is burnt in large quantities in one place, and this liberated energy is distributed by the aid of electric currents than by any other method. 1¾ col. and 1¼ col. respectively.—*Mech. Wrld.*, June 15th and 22nd, 1900.

2. Copper.

Copper.—*The Chemistry of Copper.* By Charles Steele Palmer, Prof. of Chemistry, University of Colorado. Abstract of a paper read by the author before the Colorado Scientific Society, in which he points out that he can deal with the subject only from the standpoint of laboratory knowledge, but adds that the time has come when it is necessary for the student to confine himself almost exclusively to a single subject in the realm of theoretical metallurgy of such metals as copper, so large is the topic. Roscoe and Schorlemmer in their volume on the metals devote 40 pages to copper alone, and in Dammer's *Handbuch der Anorganischen Chemie* 120 pages are devoted to a bare encyclopædic statement of the most essential details of copper, while a fairly complete statement and discussion of all the material known at present regarding copper probably could not be compressed in much less than 1,000 octavo pages. 3½ cols.—*Aust. Min. Stand.*, June 14th, 1900.

3. Gold, Silver and Gems.

Diamonds and Gems.—*Gems in New South Wales.*—Concise description of gem-bearing regions in the above-named British colony, the method of mining, and the value of the products. 1½ col.—*Austr. Min. Standard*, May 17th, 1900.

Gold Mining.—*Gold Mining in Georgia.* Description of the plant and machinery in course of erection near the Dahlonga Goldfields in Georgia, which, sixty years ago were famous, but later were abandoned, as for their

working special machinery was required. Such machinery is now to be used by six great mining companies, organised within the last eighteen months, with a total capital of $20,000,000. (Ill.) 4¾ cols.—*Sci. Am.*, July 7th, 1900.

Gold Mining.—*Cape Nome, Alaska Gold Region.* Digest of a report by Messrs. F. C. Schrader and A. H. Brooks, of the United States Geological Survey, who visited the district in October, 1899, containing very interesting information regarding the general geological formation of the region, the localities and strata where the gold is found, the methods of mining in vogue, the climate, vegetation, character of the population, etc. 6 cols.—*Mines & Minerals*, July, 1900.

—— *Gold Mining in the Transvaal.* By Dr. Chas. Heinzerling, Frankfort-on-the-Main. Description of the exhibit of the Transvaal, in charge of Mr. Knoff, engineer, consisting of a model showing in every detail the various mining and metallurgical processes of the most modern kind in use in the Transvaal, and working about 2 tons of ore each day, supplied by the 500 tons which have been specially shipped for that purpose from the Transvaal to the Paris Exhibition. (Ill.) 3¾ cols.—*Dingler's Polyt. Journ.*, July 28th, 1900.

—— *Placer Mining in the Southern Ourals.* By Charles Tappan. The article gives a description of the mining conditions in the South Oural Placer District which is of interest to miners and mining engineers of all countries, since the Russian Government is granting mining rights to foreigners. (To be continued.) 2¾ cols.—*Engrg. & Min. Journ.*, July 14th, 1900.

4. Iron and Steel.

Bessemer Steel.—*Cupola in Bessemer Works.* By S. M. Rogers. The author grants that there is no essential difference in the construction of the cupola used in Bessemer steel works and the cupola used in ordinary foundry practice, but adds that the circumstances and conditions governing the proper manipulation differ, and these differences may be worthy of some consideration. 2 cols.—*Am. Mfrr.*, June 28th, 1900.

Iron Mining.—*The Iron Ore Industry of Bilbao.* Digest of a very important report, containing valuable statistics, by Mr. Le Larrea, the British Vice-Consul, on the output of iron ores in Bilbao, the condition of the mines, and the shipping. 2½ cols.—*Iron & Coal Trds. Rev.*, July 6th, 1900.

Iron and Steel Tests.—*Specifications and Testing Materials.* Digest of a very interesting and useful paper by Mr. A. L. Colby, presented to the Congress of testing materials at Paris, such being a review of the American standard specifications, test pieces, and methods of testing iron and steel, adopted by Committee No. 1 of the American section of the International Association for Testing Materials. (To be continued.) 2½ cols.—*Iron & Steel Trds. Rev.*, July 13th, 1900.

Steel Manufacture.—*The Talbot Open Hearth Continuous Steel Process at the Pencoyd Steel Works.* Abstract from a paper read before the Iron and Steel Institute of Great Britain by Mr. Benjamin Talbot, and published in *Engineering* of June 22nd. 7 cols.—*Engrg. News*, July 12th, 1900.

5. Mining and Mining Methods.

Automatic Firing.—*Automatic Coal Handling Plant at the Leeds Electric Power Station.* Description of one of the latest designs for the automatic firing of steam boilers, carried out in connection with the steam boilers installation at the Corporation Electric Works, Leeds, by Mr. Harold Dickinson, Ass. M. Inst. C. E., the chief engineer. (Ill.) 2 cols.—*Mech. Engr.*, July 14th 1900.

Haulage.—*Machinery for the Garesfield and Derwenthough Incline Railway.* The article gives a detailed description of the hauling plant recently constructed to the designs of Messrs. Sheffield & Twinberrow, of 13, Moseley Street, Newcastle-on-Tyne, for the Garesfield and Derwenthough Incline Railway, belonging to the Consett Iron Company, a railway intended to facilitate communication between the Company's Spen Collieries and the main line of the North-Eastern Railway Company. (Ill.) 2 cols. (To be continued).—*Engrg.*, July 13th, 1900.

6. Miscellaneous.

Aluminium Industry.—*Recent Progress in the Aluminium Industry.* A paper by Prof. Joseph W. Richards, Lehigh University, in which the author describes the enormous progress made in the use of aluminium within the last few years, and dwells on its widespread employment, being now cheaper even than brass, although 75 years ago it was unknown. 7½ cols.—*Journ. of Franklin's Inst.*, June, 1900.

Annealing.—*An Annealing Machine.* Description of a heating machine specially designed and built for the United States Mint at Philadelphia by the American Gas Furnace Company of 23, John Street, New York, for the purpose of annealing bars and strips of silver. (Ill.) 2½ cols.—*Am. Mach.*, July 5th, 1900.

Concentration of Ores.—*Concentration of Ores by Petroleum.* By Charles M. Rolker. Abstract of a paper by the author, in which he describes from his own observation what is known as the Elmore Process in use on copper rock at Glasdir, Wales, consisting in a device for separating the metallic from the rock constituents of ore, by mixing the pulverised ore first with water in considerable quantity; then adding to the mixture an oil which adheres to the metallic constituents, but not to the wet rocky constituents, allowing the water carrying the rocky material to subside, while the oil-carrying metallic constituents floats above, and separating the oil from these constituents, the oil used being the thick tarry residue of mineral oil, called "residuum" after some of the more volatile constituents have been distilled off. 2 cols.—*Am. Mfrr.*, June 28th, 1900.

Conveyor and Elevator System.—*A New Pan Conveyor and Elevator System.* The article deals with a system of pan conveyor and elevator, introduced by Mr. A. B. Young, of 37, Walbrook, London, E.C., Manager of the Bradley Pulverizer Company, the characteristic feature of the system being the material is transferred from the receiving to the discharging point without change. ½ col.—*Iron & Coal Trds. Rev.*, July 13th, 1900.

Metallurgical Facts.—*On the Phenomena which accompany the Permanent Deformation of Metal.* By Major Hartmann. The author summarises in this report of his experiments the diverse phenomena that accompany the permanent deformation of metals when subjected to a strain beyond their elastic limits. 1 col.—*Iron & Coal Trds. Rev.*, July 6th, 1900.

—— *Crystallisation of Metals.* Abstract of a paper read by Mr. E. B. Gilmour before the American Foundrymen's Association. The author in this paper discusses a subject on which but little has been written, and which nevertheless is of the greatest importance for those who have to design castings. 1¾ col.—*Iron & Coal Trds. Rev.*, July 6th, 1900.

Metallurgical Methods.—*Notes on Lead Smelting and Gold and Silver Refining.* By Malvern W. Iles. In this article the author, formerly superintendent of the Globe Smelting and Refining Company, at Denver, Colorado, describes a novel and accurate manometer, invented by his former assistant, Mr. M. S. Fallis. (Ill.) 2 cols.—*Engrg. & Min. Journ.*, June 30th, 1900.

Lead Mining.—*The Metallurgy of Lead in the Province of Murcia, Spain.* Digest of an interesting contribution by M. Adrian Contreras, published in his paper, the *Revista Minera*, dealing with lead mining and lead foundries in the province of Murcia, Spain, and pointing out desirable improvements. 6 pages.—*Mem. et C. R. de la Soc. des Ing. Civ. de France*, June, 1900.

Manganese.—*Manganese in Brazil.* The article gives summary statistics regarding the world's production of manganese ores, which in 1899 was 800,000 tons, of which Russia supplied 369,000; and then dwells on the fact that manganese mining is gradually assuming larger proportions in Brazil, where there are large deposits. 1¼ col.—*Mod. Machy.*, July, 1900.

Miners' Equipment.—*Safety Shot Igniter.* Digest of a report presented by Mr. G. Chesnan, Chief Inspector of Mines to the French Firedamp Commission, in which the author gives the results of experiments made with a new system of safety igniter for firing shots in gaseous mines, which had been submitted to the Minister of Public Works by Messrs. Davey, Bickford, Smith & Co., manufacturers of dynamite and detonators at Rouen; and says that he considers that the igniter in question presents the very highest degree of safety. 1¼ col.—*Mines & Minerals*, July, 1900.

Mining.—*The Nature and Yield of Metalliferous Deposits.* By Bennett H. Brough. This is the first of a series of Cantor Lectures, delivered January 22nd, 1900, and treats, as the author says, of a subject of great commercial importance—namely, the great ore deposits of the world, and the working methods employed. (Ill.) 23 cols. *Journ. Soc. Arts*, July 20th, 1900.

—— *Peculiarities of Mine Mechanics.* By J. C. Taylor. The author, who is not a miner, describes what he saw during a recent visit in the zinc mines of Missouri and Kansas, and believes that for this very reason he may be in a position to offer some suggestions regarding points overlooked by the professional miner, who is too accustomed to the exciting conditions to notice what is lacking. 3½ cols.—*Mod. Machy.*, July, 1900.

Nickel Mining.—*Nickel Mining in New Caledonia.* Description of some of the features of nickel mining as carried on in New Caledonia, where the nickel ores are found in the serpentines in irregular veins and fillings of the shattered surface rock. ¾ col.—*Engrg. & Min. Journ.*, June 23rd, 1900.

Mining Safety Lamps.—*Safety Lamps: Past and Present.* This comprehensive contribution on the subject gives a historical review of the gradual perfection and improvement of the miner's lamp from the earliest time, when torches and little earthen oil lamps were used, until the Davis patent lamp. (Ill.) 5½ cols. and 2½ col. respectively.—*Iron & Coal Trds. Rev.*, June 29th and July 6th, 1900.

Steel and Iron Testing.—*Tension Tests continued, with a Description of the Emery Testing Machine.* By Edward F. Miller. The author describes a 300,000-lb. emery testing machine, built by Wm. Sellers & Co. for the Massachusetts Institute of Technology, able to test in compression specimens up to 18 ft. in length, and in tension up to 13 ft. (Ill.) 4 cols.—*Am. Machy.*, July. 1900.

MUNICIPAL ENGINEERING.

1. Gas Supply.

Gas Manufacture.—*Naphthaline from Retort to Point of Deposition.* By Mr. William Young, of Peebles. The author dwells on the great amount of trouble occasioned during the manufacture and distribution of gas by the fact that the naphthaline present at all ordinary temperatures passes directly from the state of vapour to that of a crystalline solid, and, in order to show how the unpleasant results are brought about, inquires into the prevailing conditions and the physical and chemical forces brought into play during the process of condensation; after which he indicates some remedies. 11 cols.—*Journ. of Gas Lighting*, June 26th, 1900.

—— *The Glasgow Gas Undertaking.* The article deals with the new works to be constructed at Provan, as authorised by Act of Parliament in August, 1899, which will cover an area of 131 acres, and, when completed, consist of four sections, each forming an independent works capable of manufacturing 12,000,000 cubic feet per day, or a total of 48,000,000 cubic feet. (Ill.) 1 col. —*Gas Wrld.*, July 7th, 1900.

—— *Retort-House Roofs.* By A. J. Walmisley, of London. Abstract of a paper read by the author before the Incorporated Gas Institute, and describing various types of roofs adapted to various and distinct conditions, together with a criticism showing the advantages and defects of various systems. (Ill.) 5½ cols.—*Journ. of Gas Lighting*, July 26th, 1900.

—— *Gas Apparatus of the Riché Type.* The article deals with the latest improvements in the Riché apparatus, as illustrated in the equipment of a little gasworks exhibited at the Vincennes annexe of the Paris Exhibition. (Ill.) 4½ cols.—*Génie Civil*, June 30th, 1900.

Gas and Waterworks.—By John Wilkinson, of Drighlington. Abstract of a paper read before the Gas Institute, in which the author refers to a paper bearing the same title presented last November by Mr. Thomas Newbigging to the Manchester District Institution of Gas Engineers, and proceeds to carry the discussion into some additional fields. 3½ cols.—*Journ. of Gas Lghtng.*, June 26th, 1900.

2. Sewerage.

Sewerage.—*Brighouse Sewage Works.* Description of a plant of sewage works, recently opened, consisting of eight tanks, having a maximum capacity of 1,100,000 gallons each, arranged so that by means of wooden services, any one or all of the tanks may be shut off, or each or any number of them worked separately. (Ill.) 5½ cols.—*Contract Journ.*, June 27th, 1900.

3. Streets and Pavements.

Pavements.—*The Paving of Streets.* Digest of a collection of particulars and opinions furnished by a number of London vestries, metropolitan district boards of works and provincial municipalities, issued from the Western Australian Agency, 15, Victoria Street, Westminster, London, under the instructions of Sir Edward H. Wittenoom, K.C.M.G., agent-general for Western Australia, in view of the issue of a report to the Corporation of the City of London on the "Comparative Durabilities of Wood and Asphalte Pavements," by Mr. D. J. Ross, C.E., the City of London Engineer, and its possible effects on the use of Western Australian timber. 6 cols.—*Bldrs. Journ.*, July 11th, 1900.

4. Water Supply.

Water Filtration.—*Filtration of great quantities of Water, Puech Process.* By M. H. Chabal, Engineer. The author describes a filtration process invented by M. Armand Puech, which has the advantage of being cheap, both as regards first cost and maintenance, and applicable to water full of impurities as well as to river water. (Ill.) 14 cols.—*Bull. Soc. Scient. Ind. de Marseilles*, Second Trimestre, 1900.

—— *The Relationship between Cost of Water Wasted and Cost of Detection and Prevention of Waste.* Abstract of a paper by Mr. A. J. Jenkins, Ass.M.Inst.C.E., read before the meeting of the British Association of Water-Works Engineers at Cardiff, in which the author, after attributing the establishment of the now almost universal system of constant water supply in this country to the detection and prevention of waste, endeavours to show the value of the results obtained at Cardiff, and adds that when it is considered that the average pressure throughout the town is but 35 lbs. per sq. in., it may be safely inferred that where pressures are higher greater saving may be expected. 2½ cols.—*Journ. of Gas Lghtng.*, July 10th, 1900.

—— *New Water Tower at Murphysboro, Ill.* Description of a steel tower and tank now under construction from the plans and specifications of Mr. Ed. Flad, M.Am.Soc.C.E., of St. Louis, Mo., to replace a steel standpipe which broke down last year at the Murphysboro Waterworks, at Murphysboro, Ill., U.S.A. (Ill.) 2 cols.—*Engrg. Rcd.*, June 7th, 1900.

—— *The Failure of the Distributing Reservoir of the Waterworks of Grand Rapids, Mich.* Description of the breakdown of a 6,000,000-gallon reservoir, forming part of the city waterworks of Grand Rapids, Mich., U.S.A., on July 2nd, caused, in the opinion of some experts, by over-filling. (Ill.) 1½ col.—*Engrg. News*, July 12th, 1900.

5. Miscellaneous.

Refuse Destruction.—By Mr. Charles Newton Russel. Abstract of a paper read before the British Iron and Steel Institute, and showing the good results obtained by refuse destructors. The author classifies the methods in use under three heads—(1) those which aim

at a cheap destruction of refuse, (2) those which make the sanitary requirements the chief object, and (3) those that have for their aim to utilise the refuse as fuel for steam-raising. 2 cols. and 4 cols. respectively.—*Am. Mftrr.*, June 28th and July 5th, 1900.

Town Refuse.—*The Economical Disposal of Town Refuse.* By Brierley Denham Healy. Abstract of a paper read before the Society of Engineers, May 7th, in which the author explains the various systems adopted for burning this refuse, and of utilising the heated gases in such a manner as to make the process truly economical. 4½ cols. and 5 cols. respectively.—*Mech. Engr.*, July 14th and 21st, 1900.

NAVAL AND MILITARY ENGINEERING.

1. War Vessels.

Battleships.—*The Battleships of the Future.* The author of the article points out that upon studying the naval programmes for the year 1900, one becomes convinced that the navies of the various Powers are rapidly tending toward a common type, differing considerably from what may be called the "bulldog" type of battleship, and then proceeds to discuss its peculiarities. 1½ col.—*Sci. Am.*, June 23rd, 1900.

—— *The Japanese Battleship "Asahi."* The present instalment, concluding the article describing this great battleship, is devoted to the auxiliary machinery, which contains a very numerous collection of machines of various types. (Ill.) 3 cols.—*Engrg.*, June 29th, 1900.

—— *The Ironclad "Fürst Bismarck."* Description of this vessel, laid down at Kiel in 1896, and at present receiving its armaments, having a tonnage of 10,640 tons, and having somewhat thinner armour-plates and less guns than the *Friedrick III.*, from which type it is derived. (Ill.) 1¾ col.—*Le Yacht*, June 30th, 1900.

—— *The Imperial Japanese Navy.* By Rear-Admiral C. C. P. Fitzgerald, A.I.N.A. Abstract of a paper read at the 41st Session of the Institute of Naval Architects, England, in which the author gives a concise description of the new but excellently equipped fleet and of its dockyards. (Ill.) 7½ cols.—*Naut. Gaz.*, June 21st, 1900.

Cruisers.—*Two Notable Foreign Cruisers.* Concise description of the French cruiser *Chateaurenault* and the Russian cruiser *Askold*, both of which are required by contract to achieve a speed of 23 knots an hour; the former has had her trials, and has exceeded 23 knots; the latter is approaching completion at the Germania Yard in Kiel. (Ill.) 1½ col.—*Sci. Am.*, June 30th, 1900.

Submarine Boats.—*A Successful Submarine Boat.* Description of the Raddatz submarine boat, with which experimental work has been going on for some time at Milwaukee, Wis., U.S.A. The boat is about 65 ft. long and about 4 ft. in diameter in the middle. When cruising on the surface the boat is driven by an oil-engine of about 10-h.p., giving a speed of from 6 to 7 miles; when submerged an electric motor is used. (Ill.) 1¾ col.—*Elec. Rev.*, July 14th, 1900.

Torpedo Boats.—*Torpedo Boat "Hydra" for the Dutch Navy.* Description of one of two first-class torpedo boats which Messrs. Yarrow & Co. have recently completed for the Dutch Government, and which are named respectively the *Hydra* and the *Scylla*. They are 130 ft. long, and have 13 ft. 6 in. beam. (Ill.) 1 col.—*Engrg.*, July 20th, 1900.

2. Equipment.

3. Armour Plates, Guns and Ammunition.

Armour Plates.—*The Manufacture of Guns and Armour at the Bethlehem Steel Works. III. Harveyised Armour.* The present article is devoted to a description of the manufacture of Harveyised armour plate, presenting the most modern method of making armour that is open to public inspection, the secrets of the Krupp process being still jealously guarded in every country where Krupp armour is made. (Ill.) 3 cols.—*Sci. Am.*, July 14th, 1900.

Gun Manufacture.—*The Kimberley Gun "Long Cecil."* By Mr. Edward Goff, Associate Member, of Kimberley. Interesting article concerning this powerful gun, constructed under very exceptional circumstances and from rather irregular material by the late Mr. George Labram. (Ill.) 5½ cols.—*Engrg.*, June 29th, 1900.

4. Miscellaneous.

Warships and Machinery.—*Progress of Warships and Machinery Building in England.* The author, after pointing out that the Admiralty still cherishes the absurd impression that it is wise to withhold all information regarding progress of work in hand from the men and public, describes the progress made from such information as it was possible to obtain.

RAILWAY WORK.

1. Motive Power and Equipment.

Cars.—*Progress in Freight-Car Construction.* The article deals with the improvement in the quality of freight-cars in recent years, and the benefit to railways in having more substantial structures in a trying service, which must show itself in a reduced cost of repair per ton-mile and in many other ways. 2½ cols.—*Ry. Master Mech.*, June 1900.

—— *New Parlour Cars.* Description of two magnificent parlour cars, the "Wyocena" and "Sparta," built by the Barney & Smith Car Company, of Dayton, O., U.S.A., for the Chicago, Milwaukee & St. Paul Railway Company, 72 ft. long each and 10 ft. wide over sills, to which are added two platforms. (Ill.) 1 col.—*Ry. Age*, June 29th, 1900.

—— *Development of the Structural Steel Hopper Cars.* The author in this article deals with the construction and efficiency of the large structural steel hopper car of 40 and 50 tons capacity—practically unknown less than ten years ago, and apparently first experimented with by the Carnegie Steel Company. (Ill.) 3½ cols.—*Ry. Age*, June 22nd, 1900.

Feed Water Strainer.—*Feed-Water Strainer—C., B. & Q. Ry.* Description of a feed-water strainer, invented by Mr. J. P. Hayes, adopted on the Chicago, Burlington & Quincy Railway, U.S.A., in place of the old design of cone strainer. (Ill.) ⅝ col.—*Ry. Master Mech.*, June, 1900.

Locomotives.—*Railway Rolling Stock at the Paris Exposition.* The author, after pointing out that, although American railway practice is in advance of all the rest of the world, the United States are very poorly represented at the Exhibition, compares the various details of rolling stock, and shows the difference between American and European machinery. 5½ cols.—*Engrg. News*, July 5th, 1900.

—— *C., B. & Q. Prairie Type Locomotive.* Description of a new type of locomotive, built after the design of Mr. F. A. Delaur, superintendent of machinery, for the Chicago, Burlington & Quincy Railway. (Ill.) 1 col.—*Ry. and Engrg. Rev.*, June 16th, 1900.

—— *Six-Wheels-Coupled Goods Engine: Waterford, Limerick, & Western Railway.* Description of locomotives lately designed by Mr. J. G. Robinson, M.I.Mech.E., and which were built by Messrs. Kitson and Co., of Leeds. They are supplied with Dewrance's water-gauges and glass protectors, Gresham & Craven's combination ejector, steam brake, and injectors (Ill.) 1¾ col.—*Ry. Engr.*, June, 1900.

—— *Single Expansion Engines with Piston Valves: State Railroad of France.* Description of four powerful engines for heavy express service at very high speed, built by the Creusot Manufacturing Company, and being single expansion engines with piston valves on the Riccur system. (Ill.) 4 cols.—*Railroad Gaz.*, July 13th, 1900.

—— *Geared Locomotives for the McCloud River Railroad.* Description of a locomotive for a railroad located at the base of Mount Shasta, California. The engine is a 60-ton Heisler locomotive, built by the Stearns Manufacturing Company of Erie, Pennsylvania. (Ill.) 2 cols.—*Engrg.*, July 20th 1900.

Locomotives.—*The Largest Locomotive Yet Built.* Description of two consolidation locomotives recently built by the Pittsburg Locomotive Works for the Pittsburg, Bessemer, & Lake Erie Ry., exceeding in weight and power all locomotives previously built. (Ill.) 2 cols.—*Ry. & Engrg. Rev.*, June 30th, 1900.

—— *Another Monster Consolidation Locomotive.* Description of a locomotive surpassing in weight and traction power probably all locomotives previously built; it is the product of the Pittsburg Locomotive Works, built for the Pittsburg, Bessemer, & Lake Erie R.R., and having an 84-in. boiler, 220 lbs. steam pressure, 24 by 32 ins. cylinder, with a traction power of 63,000 lbs. 3½ cols.—*Am. Engr. & R. R. Jour.*, July, 1900.

—— *Recent Locomotive Practice in France.* By M. Edouard Sauvage, Assistant Engineer-in-Chief, Rolling Stock and Running Department, Western Railway of France. Abstract of a paper read before the Institution of Mechanical Engineers. (Ill.) 6½ cols.—*Mech. Engr*, July 7th, 1900.

—— *A Decade of Car and Locomotive Construction.* By George L. Fowler. The author tries to demonstrate that the progress made in the construction of locomotives and cars is due less to general change than to development of details, and to solidity and efficiency; the radical changes being the introduction of steel cars and their trucks and of compound locomotives; incalculable service having been rendered by improved shop tools and the production of higher grades of metal. 3 cols.—*Ry. Age*, June 15th, 1900.

—— *Locomotive Development from 1890 to 1900.* By F. W. Dean. The author reviews the progress of locomotive building since the advent of the compound locomotive ten years ago, and suggests the building for American railroads of a locomotive with two inside and two outside cylinders with their cranks opposite on each side of the engine. 4 cols.—*Ry. Age*, June 15th, 1900.

—— *Locomotive Blast Pipes.* Digest of a report by Messrs. C. H. Onereau and Edmond Sauvage to the International Railroad Congress on the subject of exhaust and draught devices, including all countries except the United States, Sweden, Norway, Denmark, and Russia, together with portions of the report of Mr. Sauvage (reproduced from the *Railway Gazette*), comprising expressions of opinion from various railroad managements on the relative values of fixed and variable exhaust nozzles and smoke stacks, illustrations of devices used, consideration of spark arresters, and of heating feed water. (Ill.) 5 cols.—*Mech. World*, July 27th, 1900.

—— *A Suggestion for Improvement in Locomotive Design.* By Prof. R. A. Smart. The author points out that, although one of the most noticeable features of modern locomotive building is the effort to save weight in details, the valve seems to have been overlooked, and suggests that the introduction of a lighter valve and yoke would result in a better and more economical steam distribution. 1 col.—*Ry. Age*, June 15th, 1900.

Railway Bearings.—*Railway Bearings: An Investigation of Causes of Hot Boxes in Railway Service, and Methods for their Prevention.* An abstract of a paper by Robert Job, Chemist to the Philadelphia & Reading Railway Co., Reading, Pa., U.S.A. (Ill.) 11 cols.—*Journ. of Franklin Inst.*, June, 1900.

Railway Test Car.—*A New Dynamometer Car—Chicago & North-Western Railway.* Description of dynamometer car of the above-named railway, in which the spring is used in a novel form, and in which the transmission of draw-bar pull from coupler to recording pen is even more distinctly novel. (Ill.) 3 cols.—*Ry. Master Mech.*, June, 1900.

2. New Projects and Lines in Construction.

Railways.—*The New Line from Courcelles to the Champ de Mars at Paris.* The present article deals with the work done by the Western Railway of France for the purpose of creating the portion of the new line situated between the station Courcelles-Cinture and the Avenue des Trocadéro. (Ill.) 12½ cols.—*Génie Civil*, July 7th, 1900.

3. Permanent Way and Fixtures.

Railroad Equipment.—*Maintenance and Inspection of Automatic Electric Block Signals.* By H. S. Balliet. Abstract of a paper read before the Railway Signalling Club, Chicago, in which the author dwells on the great importance of the efficiency of the signalling apparatus on which the quick and safe handling of the traffic depends. 2 cols.—*West Elect'n.*, June 9th, 1900.

Railway Ties.—*Steel Ties on the Huntingdon and Broad Top Mountain R.R.* The article draws attention to the importance of experimenting with steel ties and of ascertaining their average life, although the day when steel ties will be commercially manufactured may be still far distant, and describes a form of steel tie which has been in experimental service on the railway above named for about six months, carrying traffic of an exceptionally heavy character, this tie being known as the "Chester" tie, and being practically identical with the "Columbian" and "Taylor" ties. (Ill.) 1½ col.—*Engrg. News*, July 19th, 1900.

Steel Rails.—*Renewing Steel Rails.* The article deals with the process for renewing steel rails devised in the United States by Mr. Kenne, for the introduction of which into other countries a company has recently been formed, and which is protected in England by various patents issued between July 3rd, 1894, and Feb. 8th, 1899. (Ill.) 4½ cols.—*Iron & Coal Trds. Rev.*, July 20th, 1900.

Tunnels.—*The Great Alpine Tunnels.* Abstract of a lecture delivered at the Royal Institution on May 25th by Francis Fox, Mem.Inst.C.E. The author, after a few general remarks on tunnelling and on tunnels in bygone days, describes the construction of the great Alpine tunnels. (Ill.) 8 cols.—*Nature*, July 19th, 1900.

—— *The Simplon Tunnel.* Description of the character of this highly-important Alpine tunnel, in course of construction, and of the methods used for excavation, ventilation, and other branches of the work, together with an illustration of the Brandt drilling machine. 5 cols.—*Engrg. Rcd.*, July 7th, 1900.

—— *Tunnelling with Shields.* Abstract of a paper by Mr. H. H. Dalrymple-Hay, describing the construction of the two tunnels under the Thames for the Waterloo and City Railway, of which works the author was resident engineer, and giving an account of the use of the Greathead type of shield for tunnelling in the clay. (Ill.) 8¾ cols.—*Engrg. Rcd.*, July 16th, 1900.

4. Transportation and Conducting.

Transportation.—*Transportation Building at the Bois de Vincennes.* The article criticises justly the serious blunder committed in dealing out lavishly considerable portions of the area devoted to the main Exhibition at Paris to meretricious side-shows, so that a great portion of the transportation exhibits had to look for shelter under ugly sheds at Vincennes. (Ill.) 1¾ col.—*Street Ry. Journ.*, July, 1900.

5. Miscellaneous.

Locomotive Factory.—*A Model Locomotive Factory.* The article describes the celebration of the completion of the first locomotive built in the shops of the Hartmann Machine Company at Lugansk, South Russia, being one of an order for 240 eight wheels coupled-compound goods locomotives of the standard type, adopted on the Russian Government railways. Lugansk is situated in the midst of a large coal and iron producing district, in which the Hartmann Company has had an extensive iron and steel plant since April, 1898, and, having secured in the autumn of that year the Government contract, decided to lay down a modern plant for the construction of locomotives, to the description of which a portion of this article is devoted. (Ill.) 2 cols.—*Engr.*, July 6th, 1900.

Railway Trains.—*Form of Train for Reducing Air Resistance.* Concise description of a train of cars specially constructed for the purpose of reducing to a minimum the air resistance in a moving train. The inventor, Mr. Frederic N. Adams, of the Baltimore & Ohio Railroad, claims that during a test his cars secured an increase of speed amounting to from seven to ten miles

per hour; no very accurate measurements of power, however, have been so far made, so that it is impossible to predict what the saving would really be, and whether the expenditure incurred would be balanced by the increase in speed. (Ill.) 1½ col.—*Street Ry. Journ.*, July, 1900.

Railways.—*The State Railways of France at the Paris Exhibition.*—The author, after pointing out the rather expensive mode of managing State Railways, devotes a special article to the exhibits of the French State Railways at the Paris Exhibition. (Ill.) 3 cols.—*Engrg.*, July 6th, 1900; 3½ cols., July 13th, 1900.

—— *The Present Status of Railway Development in China.* Abstract, accompanied by a map, of an article in the May number of the *Revue Générale des Chemins de Fer*, by Mr. M. G. Bouillard, describing the various lines in operation, under construction, and projected in China. 2½ cols.—*Engrg. News.*, July 5th, 1900.

Tests of Railway Work.—*A Railway Test Car.* Description of a railway test car being built and approaching completion at the Burnside shops of the Illinois Central Railroad at Chicago, to be operated jointly by the railroad named and the railway mechanical engineering department of the University of Illinois; it is designed for general railroad experimental work, and is adapted for the following purposes, for which it has special equipment:—(1) Measurement of train resistance; (2) autographic track inspection; (3) locomotive road tests; (4) air brake tests; (5) station tests. Hydraulic transmission of the pressure and motion has been adopted. (Ill.) 2 cols.—*Ry. Age*, July 6th, 1900.

STREET AND ELECTRIC RAILWAYS AND TRAMWAYS.

1. Trolley Lines.

Brake-Shoes.—*A New Idea in Brake-Shoes The U-Shoe.* Description of a brake shoe designed to provide a brake shoe of great durability, which has a constant and uniform action throughout its life, without injurious effect on the wheel, and to secure this extra endurance at as little expense of the holding power as possible. 1 col.—*Ry. Master Mech.*, June, 1900.

Overhead Lines.—*The Electric Tramway in Como.* Description of a temporary tramway line installed by the Helios Electric Construction Company on the occasion of the Volta Exhibition for the conveyance of visitors from the railway station of Ferrona Mediterranea and the steamer landing-place. (Ill.) 2½ cols.—*Tramw. & Ry. Wrld.*, July 5th, 1900.

—— *Overhead Electric Tramways for London.* This article gives a historical sketch, a description of the new lines and their equipment, and a general review of the whole question, and emanates from the pen of Mr. J. Clifton Robinson, the Managing Director and Engineer to the London United Tramways and the Imperial Tramways. (Ill.) 25 cols.—*Tramw. & Ry. Wrld.*, July 5th, 1900.

—— *An American Electric Street Railway in Geneva, Switzerland.* Description of a plant to be erected in Geneva by what is known as the Compagnie Genevoise des Tramways Electriques, which has acquired a concession for the construction of 15 kilometres (9½ miles) of road along the shore of the Lake of Geneva, from Geneva to the village of Ibermanse, on the French border. (Ill.) 1½ col.—*Elec. Rev.* (New York), May 20th, 1900.

—— *Some of the Principal Types of the Overhead Trolley.* By Spencer Baird Prentiss. The author deals with the merits and defects of the various devices for solving important problems entering into the construction and maintenance of the electric railway, and for providing satisfactory means of electrical connection between the moving car and a supply conductor placed along the line of the road. 3½ cols.—*Elec. Rev.*, June 27th, 1900.

—— *Southampton Corporation Electric Tramways.* Description of the plant of the Southampton Corporation, which in 1898 acquired the undertaking then belonging to the Southampton Tramways Company; this plant consists of six shunt-wound two-pole Crompton dynamos coupled direct to five Willans engines and one Bellis engine, these dynamos being of various sizes, the largest sets being of about 100-un. capacity and generating 235 volts. When running on the traction load they are coupled in pairs in series, giving 470 volts; as the line pressure is 500 volts, the additional E.M.P. is provided by means of boosters. (Ill.) 5½ cols.—*Elec. Rev.*, July 20th, 1900.

Overhead Lines.—*Tramways of Nice and the Littoral.* Description of an electric road under construction connecting the towns along the Riviera from Cannes, France, to Mentone, Italy, the entire equipment of which is in the hands of the French Thomson-Houston Company, of Paris. (Ill.) 3½ cols.—*Street Ry. Journ.*, July, 1900.

—— *A Recent Hungarian Suburban Electric Railway.* By Julius von Fischer and Dr. Alfred Brunn. Description of a good specimen of a Continental suburban line opened last year, and connecting Budapest and Budafok, in Hungary. (Ill.) 4 cols.—*Street Ry. Journ.*, July, 1900.

—— *The Vincennes Exposition Railroad.* Description of a "temporary" double-track trolley line which unites the annexe at Vincennes with the main exhibition grounds, following the line of fortifications past the Bois de Vincennes, branching out into a loop at the main entrance to the exhibition. It is equipped by the French Thomson-Houston Company, under supervision of its engineer, M. M. A. N. Connett, and was first put in operation on May 12th, but it is doubtful whether it will be a paying property at first, as the Vincennes annexe gives but little promise of becoming a popular resort. (Ill.) 4 cols.—*Street Ry. Journ.*, July, 1900.

2. Surface Contact Lines.

3. Miscellaneous.

Electric Railways.—*The Largest Electric Railway Company in Germany.* Description of the plant of the Union Elektricitäts Gesellschaft of Berlin, which is equipping nearly the entire system of tramway lines in the German metropolis with electric driving apparatus. This system, when completed, will comprise 775 am. (294·5 miles) of track. The most important section of the local traffic lines, and the largest undertaking of its kind in Europe, is the Grosse Berliner Strassenbahn, which has a stock capital of over M.67,000,000 (3,350,000 pounds sterling); about one-half of its lines are operated by electricity, and probably not later than two years hence electricity will be the only motive power employed. (Ill.) 7½ cols.—*Street Ry. Journ.*, July, 1900.

—— *Some Notes on the Operation of the Power Plant of the Chicago & Milwaukee Electric Railway Company.* The description of a plant with some rather universal features, among them a complete polyphase transmission system from the power station to sub-stations with rotary converters and storage batteries; second, the Arnold system of coupling several engines and generators to each other in any desired combination; the use of a cooling table for condensers. The very satisfactory operation of these three features is explained, though in a reverse order to that in which they are here mentioned. (Ill.) 6 cols.—*Street Ry. Journ.*, July, 1900.

—— *The Worcester and Webster Electric Railway.* Description of the latest of the six suburban lines which practically connect the City of Worcester, Mass., U.S.A., with the principal towns and villages within a radius of 20 miles. The line described is distinguished by thoroughness of construction, high speed, and convenience. (Ill.) 4 cols.—*Street Ry. Journ.*, July, 1900.

Electric Traction.—*Westinghouse Traction Apparatus in Paris.* The article deals with the extensive use of Westinghouse apparatus for electric traction in Paris, comprising the permanent railway plant in and about the city, and the temporary exhibits and systems of transportation in the Exhibition. (Ill.) 2 cols.—*Tramw. and Ry. Wrld.*, July 5th, 1900.

—— *Polyphase Electric Traction.* Abstract of a paper by Prof. C. A. Carus-Wilson, of London, read before the Institution of Mechanical Engineers, the first part of which deals generally with the Polyphase system and its application to railways, and the second part of

which is devoted to a description of acceleration tests made on the Burgdorf Railway, Switzerland. (Ill.) 3 cols. (To be continued.)—*Engrg.*, July 20th, 1900.

Electric Traction.—*Polyphase Electric Traction.* By Prof. C. A. Carus-Wilson. The author discusses the various features of the Polyphase system, particularly those relating to punctuality and frequency of train service and the factors determining its applicability for substituting electricity for steam on railways. (Ill.) (To be continued.) 5 cols.—*Mech. Engr.*, July 21, 1900.

—— *Cast, Weld, and Surface Contact Bonds.* By W. E. Harrison, Elec. Engr. The author publishes the results of some tests showing that the cast weld-joint alone has a resistance 30 per cent. greater than the solid rail section, that the use of sheet copper, as furnished by the Ajax Company, makes the combined resistance 20 per cent. less than the solid rail section, and that where the cast weld-joint is not employed the bond known as "Ajax" makes the most efficient type. (Ill.) 13½ cols. —*Journ. of Frankl. Inst.*, June 1900.

—— *The Dover Safety Car Fender.* Description of a fender to be attached to tramway cars to protect persons or animals when knocked down by accident from being run over or struck by the buffer; it has been adopted by the English Electric Manufacturing Co., at Preston, and is the property of the Dover Safety Car Fender Company, being manufactured by Messrs. Dick, Kerr & Co., of London. (Ill.) 1 col.—*Contract Journ.*, June 27th, 1900.

—— *Electric Tramway Exhibition. II.* (Conclusion.) This concluding portion deals with the exhibit of Messrs. Dick, Kerr & Co., Ltd., that of the Consolidated Car Heating Company, of New York, U.S.A., the displays of Messrs. Doulton and Co.; of Messrs. Witting Bros., of 49, Cannon St., showing a number of productions from their works in Belgium and France; of the Chloride Electric Storage Syndicate and of the Electric Power Storage Co.; of Meldrum Bros., and a few other exhibitors. (Ill.) 8 cols.—*Mech. Engr.*, July 28th, 1900.

—— *Southport Electric Tramways.* Description of the new lines recently opened, having an extent equivalent to 6 miles of single track, and being constructed and fully equipped within six months. After the completion of one or two small link lines Southport will be in possession of about 18 miles of tramways. (Ill.) 4½ cols.—*Elec. Rev.*, July 27th, 1900.

—— *A Long High-Speed Electric Railway.* The article deals with the plant and equipment of the Detroit, Ypsilanti and Ann Arbor Electric Railways, which serves as an object lesson of importance to small railways in the United States as well as in other countries. The length of track is 50 miles, the main line from Detroit, Michigan, passing through Wayne and Ypsilanti, covering 40 miles, while a branch from Ypsilanti to Salini has a length of 10 miles. (Ill.) 7 cols.—*Elec. Rev.* (New York), July 4th, 1900.

—— *North-Western Elevated Railroad.* Description of an elevated railroad in Chicago, opened on May 31st, on which the third-rail system is used for electric traction, 78-lb. 30-ft. rails being used for the electrical conductor, and these rails are electrically connected by a flexible bond. 4 cols.—*West Elect'n.*, June 23rd, 1900.

—— *Test of the Buffalo Street Railway Plant.* The article deals with an elaborate experiment, rather long in duration, and requiring a large number of observers, conducted in the latter part of February of the present year in Buffalo, N.Y., U.S.A., at the request of Mr. R. E. Danforth, superintendent of the Buffalo Railway Company, by the Department of Experimental Engineering, Sibley College, Cornell University, with the object of determining the relative value of three conditions of operation, and, in addition, to ascertain the economics of boilers, engines, and electrical equipment. 2 cols.—*Engrg. Rcd.*, June 30th, 1900.

Light Railways.—*Light Railways from a Country Surveyor's Point of View.* Abstract of a paper by H. T. Wakelam, County Engineer and Surveyor of Middlesex, read before the Incorporated Association of Municipal and County Engineers, in which the author expresses himself in favour of a county scheme, thinks that it is contrary to public policy to grant monopolies over main roads; but if the latter are to be used for light railways, the system should be a complete one. 2½ cols.—*Elec. Engr.*, July 27th, 1900.

TRADE AND ECONOMICS.

1. Commerce and Trade.

2. Industries.

Phosphate Industry.—*The American Phosphate Company's Plant, near Mount Pleasant, Tenn.* By George F. Blackie. Abstract of a paper read before the Engineering Association of the South (U.S.A.), in which the author describes the complete washing, drying, crushing, and screening plant of the above named company, just finished, on the line of the Mount Pleasant Southern Railway in Tennessee. 2 cols.—*Engrg. & Min. Journ.*, July 7th, 1900.

Weaving Machinery.—*An Improved Loom for the Weaving of Bordered Fabrics.* This is a description of an ingenious mechanical device employed by the Oriental Fabrics Co., Union Hill, Rochdale, for weaving "dhooties" which have a brilliantly coloured border, and which heretofore could not be produced mechanically as brilliant as those which are woven by hand by the natives of India. (Ill.) 2 cols.—*Textile Recorder*, July 14th, 1900.

3. Labour.

Labour Conditions.—*Comparison between Hand and Machine Labour.* Digest of a lecture on the subject by M. E. Levasseur, member of the Institute, in which the author demonstrates that the introduction of machine labour, far from injuring the condition of workmen, is enormously improving it. 3 cols.—*Génie Civil*, June 30th, 1900.

THREE IMPORTANT ANNOUNCEMENTS.

WILL SHORTLY APPEAR.

"Feilden's Magazine" Mining Number.

Dealing exhaustively with the present and future of the Rand, Westralia, and other world's mining properties and interests, and the work, ***machinery*** and ***processes*** in connection therewith.

Arrangements are being made to include this important matter in the November issue. Famous mining experts will contribute the articles, which will be extensively illustrated.

Modern Appliances in Gas Manufacture.

By the late G. E. Stevenson, M.I.C.E., and F. W. Stevenson, M.I.C.E., with an additional chapter on Carburetted Water Gas, by Samuel Cutler, Junr., M.I.MECH.E., profusely illustrated. This work will form the most modern record of the Science, from the Coal Mine to the Consumer.

The Building of a Great Railway.

A complete history of the construction of the Great Central Railway extension to London. Fully illustrated from photographs and working drawings, treating exhaustively of the Line, Locomotive rolling stock, all ***machinery and plant,*** including a description of the signalling and running arrangements.

This work will be the only modern history of the building of this Great Railway.

REVIEWS.

The Locomotive of To-Day. Demy 8vo., 178 pp., illus. London: The Locomotive Publishing Co. Limited, 1899. Price 2s. 6d.

This excellent little manual contains much serviceable information concerning the various constructional details of the locomotive, it represents modern English practice with considerable accuracy. In several instances reference is made to Continental and American design, and this enhances the value of the treatise. The book is divided into five sections under the following headings:— the boiler, the engine, framing and wheels, tender and brakes, examples from modern practice; and the subject is handled in an eminently practical fashion. In the closing section several good illustrations of recently built locomotives will be found. The text is accompanied by a number of drawings, and, in most instances, the scale of these is added. The compilers are to be congratulated on the manner in which they have explained each detail in simple and practical terms, stating the reasons for the adoption of the different designs employed. The opportunity of securing a book so thoroughly detailed and up to date at a nominal price should not be overlooked, as it will well repay the perusal of engineering students, mechanics, and others engaged in locomotive work. The publishers have executed their work in creditable style.

English and American Lathes. By Joseph G. Horner, A.M.I.Mech.E. London. Whittaker & Co., Paternoster Square.

Any publication, and particularly in book form, which deals with the subject of Machine Tools is likely to attract the attention of Engineers at the present time. Considering the importance of the Machine Tool industry it is surprising what little is written about it outside magazine articles. Mr. Horner has confined hinself to one class of tool only, viz:—the Lathe, and compares English and American types. In his preface he points out that the present volume is based upon a series of articles which he wrote for one of the technical weeklies, and that the reason for its present publication "is the growing importance of the American Lathe Trade in England." Bearing in mind the author's stated object, and after intelligent perusal of the contents, we cannot say we are much impressed with his book. Whilst containing a number of useful diagrams shewing sections of the various parts of lathes, it has too much the appearance of a trade catalogue, and this idea is not lessened by the knowledge that trade advertisements occur at the end of the volume. Moreover, several of the illustrations shown, and which are stated to represent standard types of English lathes, are, if we mistake not, by firms certainly not recognised as our leading makers, even if they are makers at all, and we miss types of several of our leading makers without reference to whom no list of lathes is complete. We take it that the book is intended to be useful to practical Engineers, men who know something about lathes and are users of them, but we doubt whether this volume is likely to be of much service to such, seeing that so much of the information given can be readily obtained from both British and American trade catalogues, and especially the latter. We must also considerably dissent from what Mr. Horner puts down as the leading features which broadly differentiate English and American lathes. For instance he says the English type have "movable headstocks rigidly coerced," whilst the American are provided with "set over adjustment." Whilst this statement might have been moderately correct some years ago, it is certainly not true to-day, as a very large percentage of modern English lathes have set over poppet heads, and in fact in one of the English types illustrated in his book, it is shown fitted with a set over adjustment. Again the same remarks apply to the comparison made of solid and hollow mandrils, in which he infers that English lathes are invariably fitted with solid mandrils and American lathes have hollow mandrils. This is somewhat misleading and incorrect, since large numbers of English lathes are made with hollow spindles. We might further criticise the comparison made, but the distinction drawn between the two types certainly does not exist to-day, and if any subject should be up-to-date, it is in relation to Machine Tools. We do not for a moment fail to recognise the importance of the many ingenious contrivances introduced in American lathes, but we venture to think that the American lathe is just now over boomed, and that if users will exercise a little care in their selection of English-made tools, they will find the British maker still leads the van in tool making. If they would also pay the price for the English tool which they so readily pay for the American machine they would get more than equal value. As we have already inferred, Mr. Horner's book contains some useful and interesting sectional diagrams, and these, taken in conjunction with the other illustrations shown, will doubtless cause the book to be of considerable value to students and others who are making initial enquiry into the subject. As a book of reference, however, its size is somewhat against it. Book-shelves as a rule are not suited to books measuring 12½ in. by 10 in. It is well printed and well got up generally, and contains 300 illustrations.

THE EDITOR of FEILDEN'S MAGAZINE invites Manufacturing Engineers to send copies of their new catalogues. The same, whether reviewed or otherwise, will be filed for the reference of Buyers in the Catalogue Department of the Feilden Publishing Co.

ANNUAL SUBSCRIBERS to FEILDEN'S MAGAZINE will be supplied with full index and title-page of any volume *free of cost*. If any regular reader of the Bookstall and Newsagent's Edition will also forward us his name and address and 1*d*. for postage we will send a copy.

THE BIRTHDAY (AUGUST) ISSUE of FEILDEN'S MAGAZINE was a phenomenal success. Considerably over our average circulation of 10,000 copies were issued and eagerly sought after. A second edition is in circulation.

IT WILL INTEREST

Suppporters of FEILDEN'S MAGAZINE to know that the Birthday Number issued last month received a measure of support which the proprietors are assured is unprecedented in the annals of industrial journalism. Within a few days after publication the wholesale trade gave repeat orders, and the demand, both direct and indirect, was exceptional. A second edition was required, and is now in circulation.

STRIKING PROOF

of the value of the magazine to the British engineering industries and to British trade is afforded by the fact that advertisers who gave their support to our pages from the inception of the magazine in August, 1899, have renewed their contracts for further extended periods, and in many cases have increased, for the Birthday Number, the spaces hitherto held by them, and this, in several instances, ***without solicitation.***

ELOQUENT AND UNSOLICITED TESTIMONY

from the responsible Press of the country has also been forthcoming in a most hearty manner. We feel pride in reproducing a few extracts from hundreds of Press notices and letters which have reached us.

The London ***Standard*** says:

"FEILDEN'S MAGAZINE is one of the most remarkable magazines published. There is not one that gives so much for the money. . . . It should be in the hands of all interested in the latest mechanical contrivances and in the progress of technical work. The illustrations of machinery are simply perfect, and nothing finer in the way of mechanical drawing could be produced. As many of them are drawn to scale they are of the utmost value to mechanical engineers and to captains of industry who give themselves to the study of improved methods. The magazine contains also a great number of excellent papers on general questions connected with international industry as well as machinery. The present is what is called 'a first Birthday Number.' One of the claims of the magazine is that it is 'militantly British, but it is the Imperialism of commerce and kinship, not of militarism,' towards which the magazine aspires."

The Nottingham Guardian, among other remarks, says:

"FEILDEN'S MAGAZINE, one of the best technical publications extant, celebrates the anniversary of its advent by the issue of a first birthday number, which, in the quality of its contents and the general excellence of its production, is specially worthy of the occasion."

The Bristol Times says:

"FEILDEN'S MAGAZINE with the current issue celebrates its first birthday, and the present number worthily upholds the high standard attained by this publication."

Commercial Intelligence, the esteemed and reputable weekly competitor of FEILDEN'S MAGAZINE, says:

"We congratulate our contemporary on this token of its success in a field where we ourselves are striving. The number is an exceedingly creditable production, and we strongly recommend every engineer to procure a copy."

Samples from Advertisers.

From the **United States Metallic Packing Co., Ltd.,** Bradford:

"Compliment you very heartily on your evident success, and trust that it may continue to your satisfaction. Enclosed herewith we hand you official order to renew advertisement."

From **Rosling, Appleby & Fynn, Ltd.,** Bradford:

"A very fine production, and we do not see how it could be improved."

From the **Williams Typewriter Company for Europe,** 104, Newgate Street, London, E.C.:

"We have just received the Birthday Number of your magazine, and it certainly is a very fine book—we believe, altogether, the best we have ever seen of its kind in any part of the world."

A few Remarks from Subscribers, etc.

From **M. Powis Bale & Co.,** Appold Street, Finsbury, E.C.:

"Enclosed please find subscription for your magazine for the ensuing year. We are very satisfied with it."

From **The Auto Machinery Co., Ltd.,** Coventry:

"We think you may well be proud of your year's effort."

From **Charles De Grave Sells, M.Inst.C.E.,** Sampierdarena, Italy:

"I must not omit to send you a line of congratulation on the success of the first two volumes, and of your efforts on behalf of British manufacturers, and sincerely hope that renewed success may attend your future efforts."

THE INCREASED SUPPORT

given to our work, justifying, as it does, the programme and policy of the magazine and the claims maintained for it from its inception, encourages us to make additional and even more vigorous efforts, if this were possible, to still further increase its sphere of practical usefulness. Our aim is to make FEILDEN'S MAGAZINE ***the*** recognised British organ ***everywhere;*** this it is fast becoming, and in the near future we hope to outstrip even our extraordinary circulation, already the biggest on record.

WITH THIS OBJECT

in view we are arranging with a considerable number of distinguished writers, artists, and other gentlemen of repute to contribute to future issues, our regular staff will be augmented and the organisation strengthened all over the country. In a word, no pains or expense will be spared not only to maintain but advance the standard of literary excellence, typography and illustrations for which the magazine has become distinguished, and everything that ingenuity and resource suggest will be done to render the magazine increasingly valuable to its supporters.